INDIA

Economic Geography

A Textbook for Class X

B. S. PARAKH

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Class - X
Rollno - 16

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Foreword

India: Economic Geography is a textbook in geography for Class X under the 10+2 pattern of education. As a follow-up of the National Policy on Education, 1986, the NCERT has revised the school curriculum for all stages. The present book together with its companion volume for Class IX entitled *Understanding Environment* has been developed on the basis of the revised geography syllabus for the secondary stage. As such, some of the core elements such as 'protection of environment', 'inculcation of scientific temper' and 'equality of sexes' as mentioned in the National Policy on Education and the Programme of Action have been taken care of.

The present book endeavours to acquaint the growing citizens of tomorrow with the temporal and spatial dimensions of the economic development of the country. Keeping in view the objectives of general education, the book follows a functional approach. Hence, emphasis has been laid more on understanding of concepts and development of skills than on mere acquisition of knowledge. Facts have been given only to be used as a means and not an end in themselves. Besides, in order to facilitate 'learning by doing', several activities have been given in the beginning of each chapter. These would help the students in developing necessary geographical skills such as 'reading and interpreting maps and diagrams', 'computation, visual representation and analysis of data', and 'transformation of visual to verbal information and vice versa'.

I am grateful to Prof. B.S. Parakh, who has authored this book. I extend my thanks to Shri Yashpal Singh for rendering it into Hindi in a very short time. I also acknowledge the valuable suggestions and comments received from the participants during the review workshop.

Due to lack of time, maps and diagrams have been taken from our earlier books with necessary modifications. Photographs for this book have been obtained from the Press Information Bureau (Nos. I and II) and *The Hindustan Times* (Nos. III, IV, V, VI, VII, VIII and IX), for which we are thankful to them.

My thanks are also due to my colleagues in the Department of Education in Social Sciences and Humanities (DESSH) and particularly to Dr Savita Sinha for coordinating and overseeing the work at all stages.

Suggestions towards the improvement of this book are welcome.

K. GOPALAN
Director
National Council of
Educational Research and Training

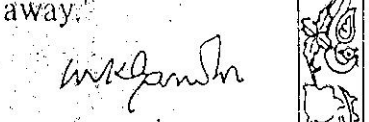
Contents

GANDHIJI'S TALISMAN

"I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test :

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it ? Will it restore him to a control over his own life and destiny ? In other words, will it lead to Swaraj for the hungry and spiritually starving millions ?

Then you will find your doubts and your self melting away."



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 uni. 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 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.

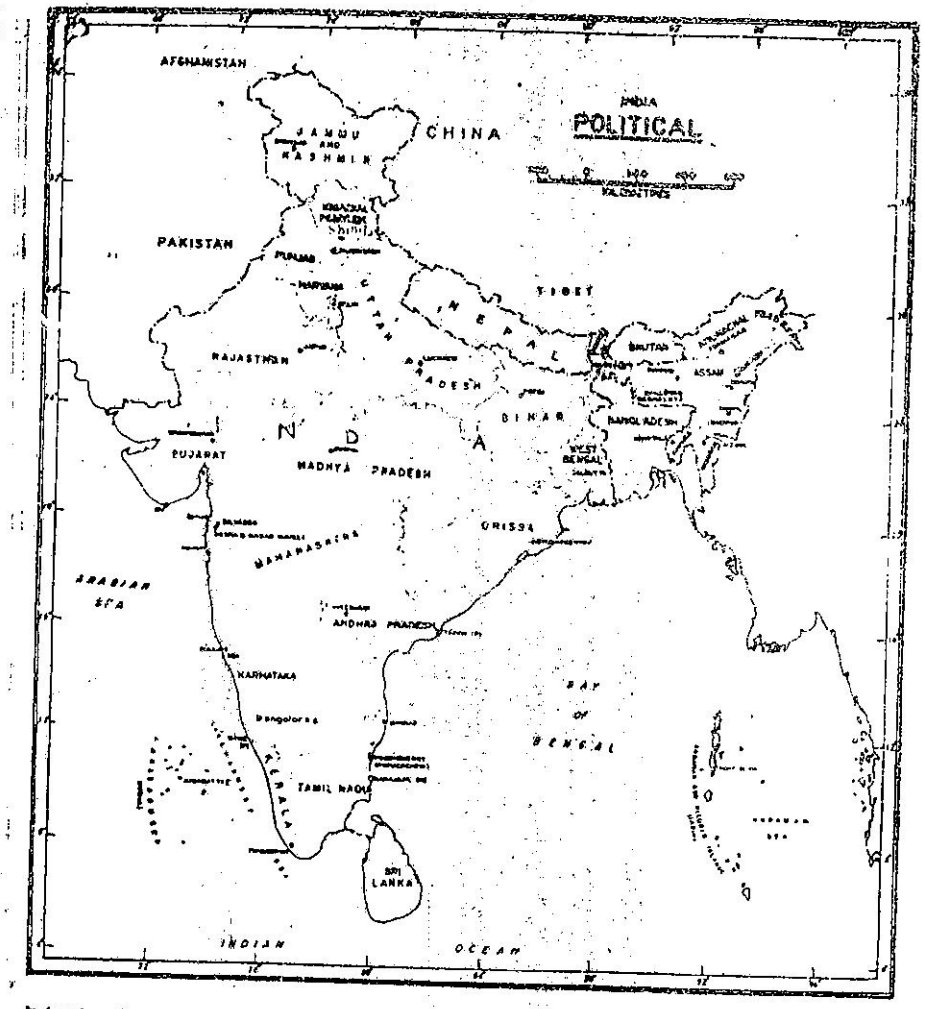
(c) Note down the degrees of latitude of the northern extremity of India.

(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 degrees of longitude of the western tip of India lying in Kachchh.

(f) Find out the degrees 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 map with the permission of the Surveyor General of India.

The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified.

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

The administrative headquarters of Chandigarh, Haryana and Himachal Pradesh are at Chandigarh.

Fig. 1.1 India—Political

The Republic of India consists of 25 States and 6 Union Territories and 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 (Burma), 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 of the same value.

(b) State the time lag between the sunrise on the easternmost and the westernmost horizons of India.

(c) State the reason for selecting a standard meridian of India with an odd value of 82° 30' E.

(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.

(e) Reason out why the difference between the duration 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 easternmost 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 other 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 south-east Asia lie towards the east. Beyond them are located the countries of East Asia.

India is favourably situated on the

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?

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.

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 northwest, India at the core, Nepal in the north, Bhutan in the north-east and Bangladesh in the east. While India, Pakistan and Bangladesh are republics, Nepal and Bhutan are kingdoms. The island states of Sri Lanka, and Maldives are [illegible] ern 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 then world was far different from what it is today. The area where the Himalaya stands today together with the Northern Plains of India was occupied by 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 it joined the south Atlantic Ocean in the Gulf of Guinea in the west. For millions of years denudation of these 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 [illegible] 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 folded mountains such as the Himalaya of today.

As the Himalaya began to gain in height, the rivers and other agents of denudation became increasingly active in eroding them, and carrying huge amounts of silt

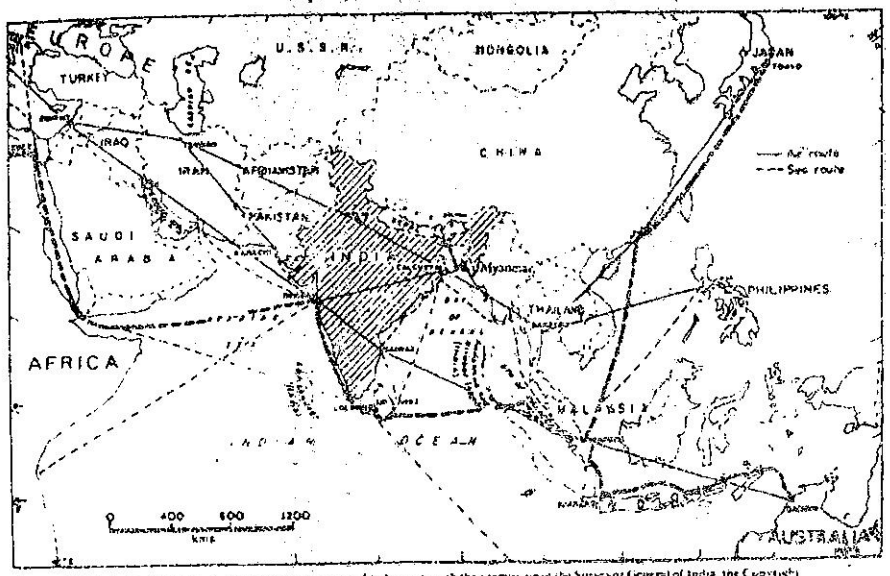


Fig. 1.3 India on the International Highway of Trade and Commerce
Note the location of India on the International trade route

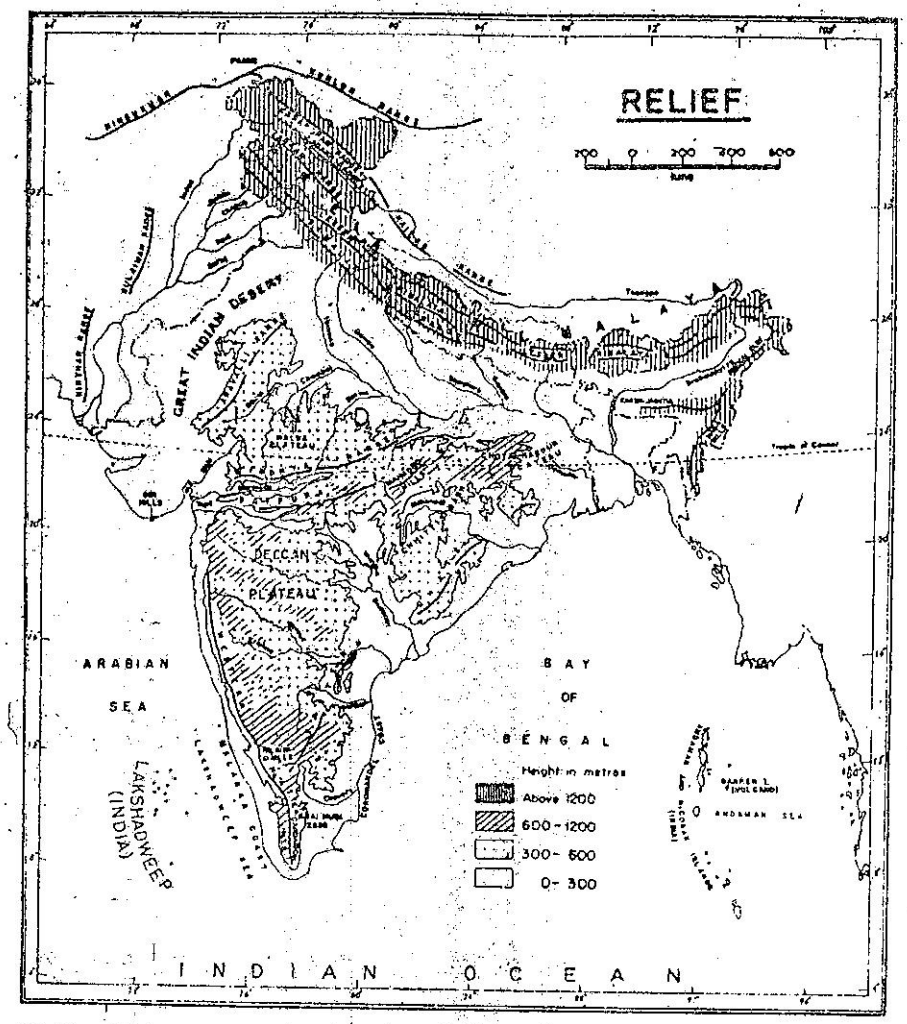
to deposit in ever-shrinking Tethys. The result has been what we call the Northern Plains or the Indo-Gangetic plains lying in India and Pakistan. The river Brahmaputra too did the same in the north-eastern part of India and Bangladesh. If you look at the map of the Ganga-Brahmaputra delta carefully 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.

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 three structural components (i) the Great Mountain Wall of the North, (ii) the Northern Plains and (iii) the Great Peninsular Plateau.

The Great Mountain Wall of the North

In the 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. slow



Based upon Survey of India map with the permission of the Surveyor General of India

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

Fig. 1.4 The Indian subcontinent—Relief

Note the three major physical divisions of India corresponding to the three structural features of the subcontinent. Note the rivers draining into the Arabian sea and the Bay of Bengal. Which of the two drainage areas is larger?

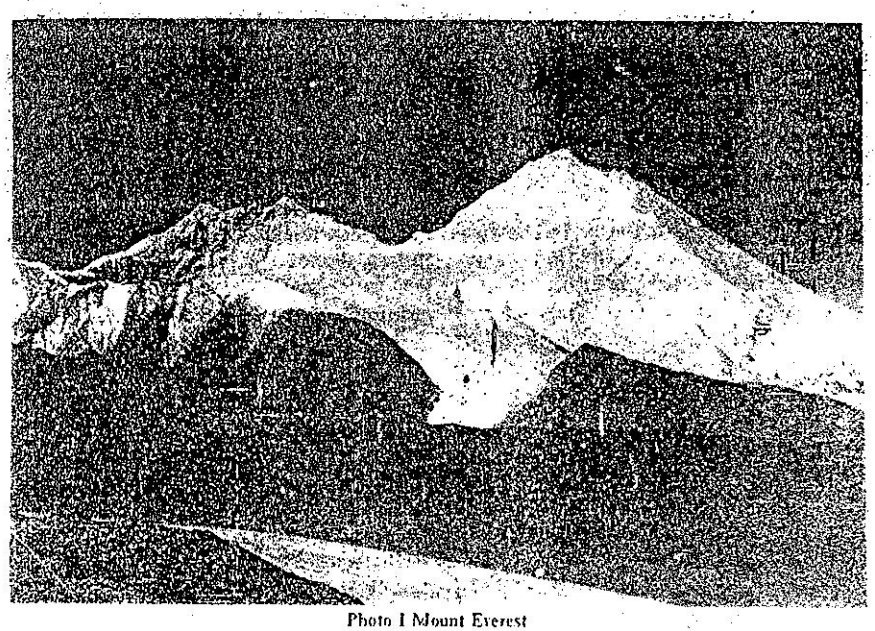


Photo 1 Mount Everest

Look at the snow covered peak of the Mt. Everest and the steep slope. You may also notice a glacier in front part of the photograph

moving solid rivers of ice, 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 extend from the Indus 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 Himalaya varies from 400 km in the west to 150 km in the east. They are wide in Kashmir and become 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 northernmost range is the loftiest of all. All the high peaks of the Himalaya belong to this range. The Mount Everest or Sagarmatha is the highest peak in the world. Its height is 8848 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. The Namcha Barwa is an important peak in the east overlooking the Brahmaputra where this range takes a sudden turn towards south to enter India. This northernmost and the loftiest range is known as the Great Himalaya or the *Himadri*.

To the south of the Great Himalaya lies the Middle or lesser Himalaya. They are 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 Dhaola Dhar in Jammu and Kashmir and Himachal Pradesh belong to the Middle Himalayas; so does the Mahabharat range of Nepal. The southernmost ranges of the Himalayas are known as 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 in Jammu and Kashmir and Himachal Pradesh are known as Western Himalaya. In Uttar Pradesh and Nepal, they are known as Central Himalaya. In West Bengal, Sikkim, Bhutan and Arunachal Pradesh they are known as Eastern Himalaya.

There are important passes in the Himalayas. Shipkila is located on the Tibet Himalayan Road 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 Himalaya are no more invincible.

The Himalaya 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 Himalaya. They flow into the Northern 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 Himalaya in a region surrounding Kailas and Mansarowar in Tibet. They flow almost parallel to the Himalayan mountains for a long distance before all of a sudden turn to the south piercing through the Himalayan mountain chain, to serve the Northern Plains. It indicates that the Himalayas are not a perfect water divide. Moreover it can be inferred that these rivers were in existence long before the Himalaya came into being and attained their height. These three rivers while crossing the Himalaya make huge and spectacular gorges or canyons. They are also called *I-shaped valleys* since the rivers on their either side have vertical walls. While the Himalayas have been rising, these rivers have been deepening their valleys.

As mentioned earlier, the Brahmaputra marks the easternmost 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 Patkoi 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 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 : Large part 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 rises in U P Himalaya at Gangotri and after reaching Hardwar it enters the Northern Plains. On its west lies the Yamuna which 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 Ganga. The big Himalayan rivers joining the Ganga down stream of Allahabad from west to east are Gomati, Ghaghara, Gandak and Kosi. The Ganga river system drains most of Haryana, southeast Rajasthan, northern Madhya Pradesh, Uttar Pradesh and Bihar. 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 hardly a fall of 300 metres in its slope. The zigzag or meandering course of the rivers tells us how level are the plains. 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 under cutting done by this powerful river is of the order of 5,500 metres. Is it not unbelievable? Here and in Arunachal Pradesh it is know as Dihang. After the confluence of Lohit, Dihang and Dibang, it is called the Brahmaputra. Besides a great volume of water, it also carries huge amounts 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 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 Kranger 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 about the young and folded

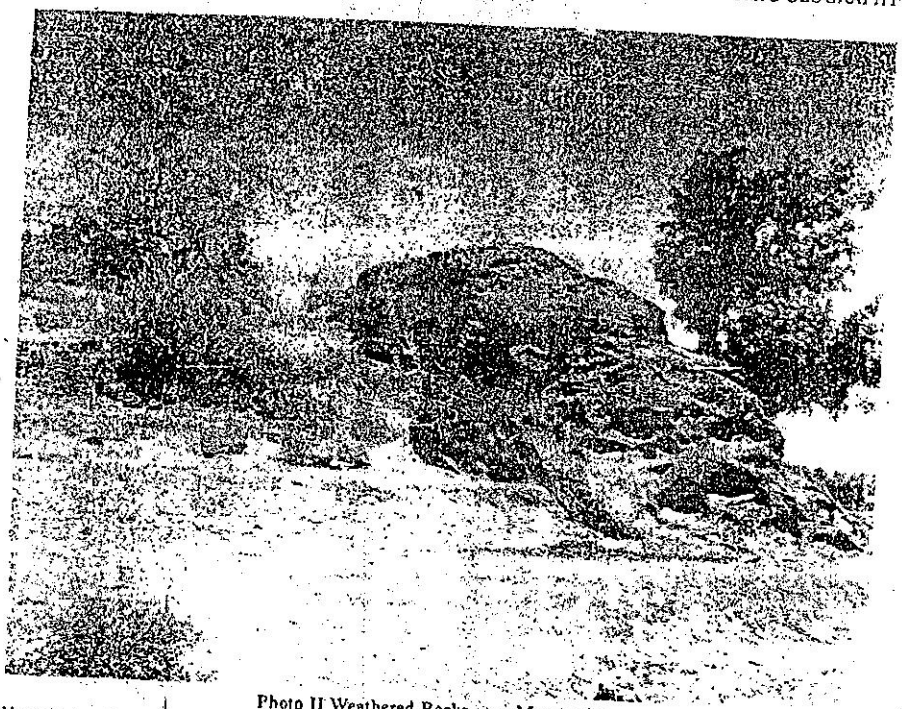


Photo II Weathered Rocks near Mount Abu

Note the peculiar nature of weathering of rocks near Mount Abu. Being part of the old mountain ranges of India, they have been denuded for thousands of years.

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 Himalaya and the Northern Plains in place of the Tethys of geological time. 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*. 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 sandy, 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 *Chotanagpur 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 Vindhya Range and its eastern extensions

namely Mahadev Hills, Kaimur Hills and Maikal Range form 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, 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 river valleys are said to be old rift valleys. They 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 from 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. There are several estuaries—the major ones being those of Narmada and Tapi in Gujarat. It is blessed with deep natural harbours like Bombay 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, are 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 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 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 these islands.

Physiographic divisions of India described above are complementary to each other. The peninsula is the stable block which has provided the building material for the Northern Plains and the Mountains. The northern mountains are the major source of water, and girdle the subcontinent.

for thousands of kilometres. This 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 make the Indian subcontinent?
   (ii) How can we determine the age of rocks?
   (iii) Why are the Himalayas called the young fold mountains?
   (iv) Which mountain ranges constitute the Purvanchal?
   (v) Which river systems constitute the Northern Plains?
   (vi) Which is the oldest landmass of the Indian subcontinent?
2. Distinguish between:
   (i) A Delta and an Estuary
   (ii) Western Ghats and Eastern Ghats
   (iii) Western Himalayas and Eastern Himalayas
3. Give one term for each of the following:
   (i) An elongated and shallow sea sandwiched between the two ancient landmasses.
   (ii) Slow-moving rivers of snow and ice.
   (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 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 a 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 Himalaya in India
   (iv) Nathula and Bomdila passes
   (v) The Indus, the Ganga and the Brahmaputra
   (iv) The Chotanagpur plateau

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 man-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

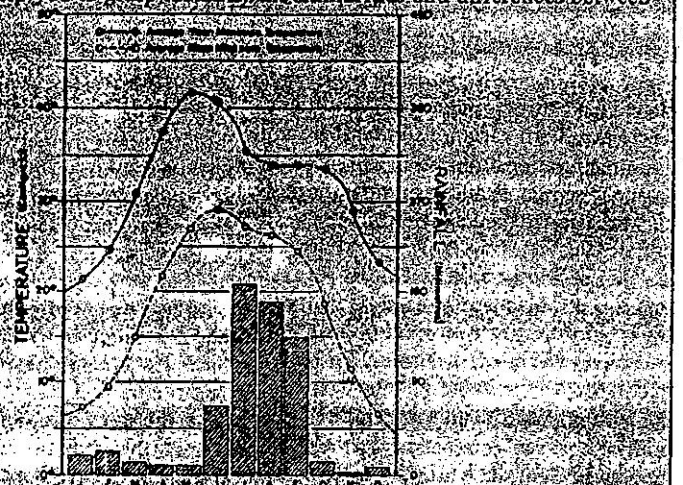
Situated roughly between 8°N and 37°N latitudes, India is divided in almost two equal parts by the Tropic of Cancer. It runs east-west just half way through the country.

See how it 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 act 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 climate. Relatively high temperatures almost throughout the year and predominantly dry winters are the two characteristic features of a tropical climate. Barring the periphery, the Indian subcontinent does exhibit these two domi-

FOR DOING IT YOURSELF

1. In Table 2.1 the average mean monthly temperatures and amounts of rainfall for 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 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:



2.1 Rainfall and Temperature of Delhi

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

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	°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	
			cm	0.7	0.9	1.1	4.5	10.7	7.1	11.1	13.7	16.4	15.3	6.1	1.3	88.9
Bombay	19°N	11	°C	24.4	24.4	26.7	28.3	30.0	28.9	27.2	27.2	27.7	27.8	27.7	25.0	
			cm	0.2	0.2	0.1	0.5	19.3	50.6	60.0	36.0	26.9	4.8	1.0	0.2	185.4
Calcutta	22°34'N	6	°C	19.6	22.0	27.1	30.1	30.4	29.9	28.9	28.7	28.9	27.6	23.4	19.7	
			cm	1.2	2.8	3.4	5.1	13.4	29.0	33.1	33.4	25.3	12.3	2.1	0.4	162.5

Delhi	29°N	219	°C	14.4	16.7	21.3	30.0	33.3	33.3	30.0	29.4	28.9	25.6	19.4	15.6	
			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	26°18'N	224	°C	16.8	19.2	26.6	29.8	33.3	33.9	31.3	29.0	29.1	27.0	20.1	14.9	
			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	16.6
Madras	13°4'N	7	°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	
			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	21°9'N	312	°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	
			cm	1.1	2.3	1.7	1.6	2.3	22.2	37.6	28.6	18.5	9.9	2.0	1.0	124.2
Shillong	25°34'N	1461	°C	9.8	11.3	15.9	18.5	19.2	20.6	21.1	20.9	20.0	17.2	13.3	10.4	
			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
Trivandrum	8°29'N	61	°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	
			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	34°N	3506	°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	
			cm	1.0	0.8	0.8	0.5	0.5	0.5	1.3	1.3	0.8	0.5	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 from 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 the both		
(viii) Two stations influenced by retreating and northeast monsoons		
(ix) Two stations receiving winter showers from the western disturbances.		
(x) Two most rainy months for India as a whole.		

3. The two hottest stations in the months of
   (a) February
   (b) April
   (c) May
   (d) June

4. Now Find Out
   (i) Why are Trivandrum and Shillong rainier in June than in July?
   (ii) Why is July rainier in Bombay than in Trivandrum?
   (iii) Why are south-west monsoons less rainy in Madras?
   (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
   — Trivandrum has equable climate.
   — Madras has more rains only after the fury of monsoons 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 Trivandrum 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.

nant characteristics.

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. 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 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 north-east trades devoid of any moisture. This is however, only half the story of the Indian climatic phenomenon. Let us know 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 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 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* is a fast flowing wind blowing in a narrow zone in the upper atmosphere. A westerly jet stream in lower stratosphere is place itself north of the Tien Shan in Central Asia. An easterly jet-stream develops at about 25°N. Low pressure and jet stream are responsible for sudden outbreak of the jet-stream at about 15°N. It is believed to be responsible for sudden outbreak of the monsoons in northern India. Its cooling effect leads to the precipitation from maritime clouds already hovering over this part. The unstable equatorial oceanic air is able to form cumulonimbos cloud 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 monsoon winds, after crossing the equator in the Indian ocean, take a southwesterly trades, a planetary system of winds. 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. 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 causation 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 under 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 known with the help of meteorological data which are collected from 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.

Over the years meteorologists have found out a seasaw kind of relationship between the meteorological changes over the Pacific and the Indian Oceans. Whenever surface pressure is high in the sub-tropical region of the Pacific Ocean in the northern hemisphere, the pressure over the southern part of the Indian Ocean tends to be low and vice versa. This causes shifting of winds across the equator in different seasons. This is known as the *Southern Oscillation*. The extent of shifting across the equator and the intensity of winds affects the monsoon. It has no fixed periodicity. The intensity of southern oscillation is mea-

sured, among others, by measuring the difference in pressure between Tahiti (roughly 20°S and 140°W) in French Polynesia in east Pacific and Port Darwin (12°30'S and 131°E) in northern 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 Madras and Calicut are 24°-25°C, they are between 10°C and 15°C in the northern plains. The days, however, are generally warm and the nights cold. Slight frost is not uncommon in places with high altitudes.

In the north-eastern 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 from 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.

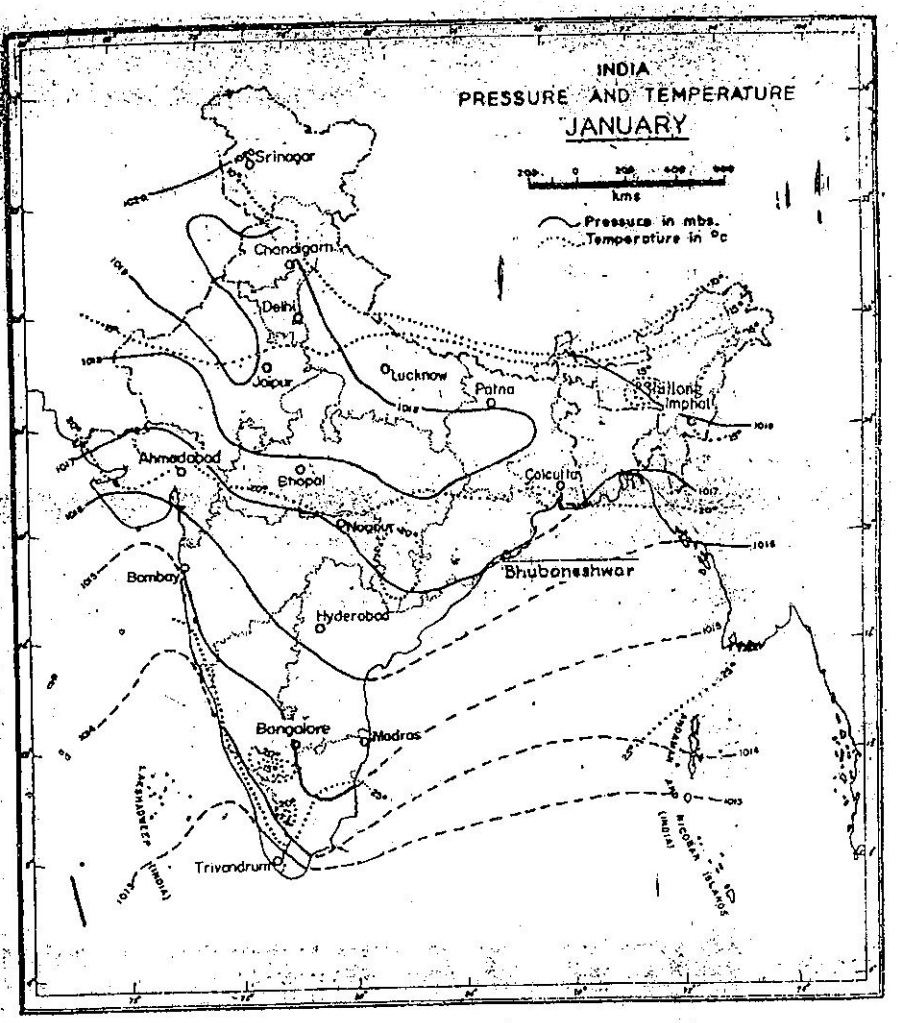
These climatic disturbances are generally preceded by warm weather or sudden rise in temperatures. After the rains, spread over a couple of days, they are followed by clear skies and drop in temperatures. Occasionally they bring in their trail severe cold waves. The cold wave is generally defined by fall in temperature by 5 or more degrees from the normal.

The only part of India benefitting from the north-east trade winds lies in the far south namely Tamil Nadu. For instance Madras 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 ap-



Based upon Survey of India map with the permission of the Surveyor General of India.
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 Areas (Reorganisation) Act, 1971, but has yet to be verified.

Fig. 2.2 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?

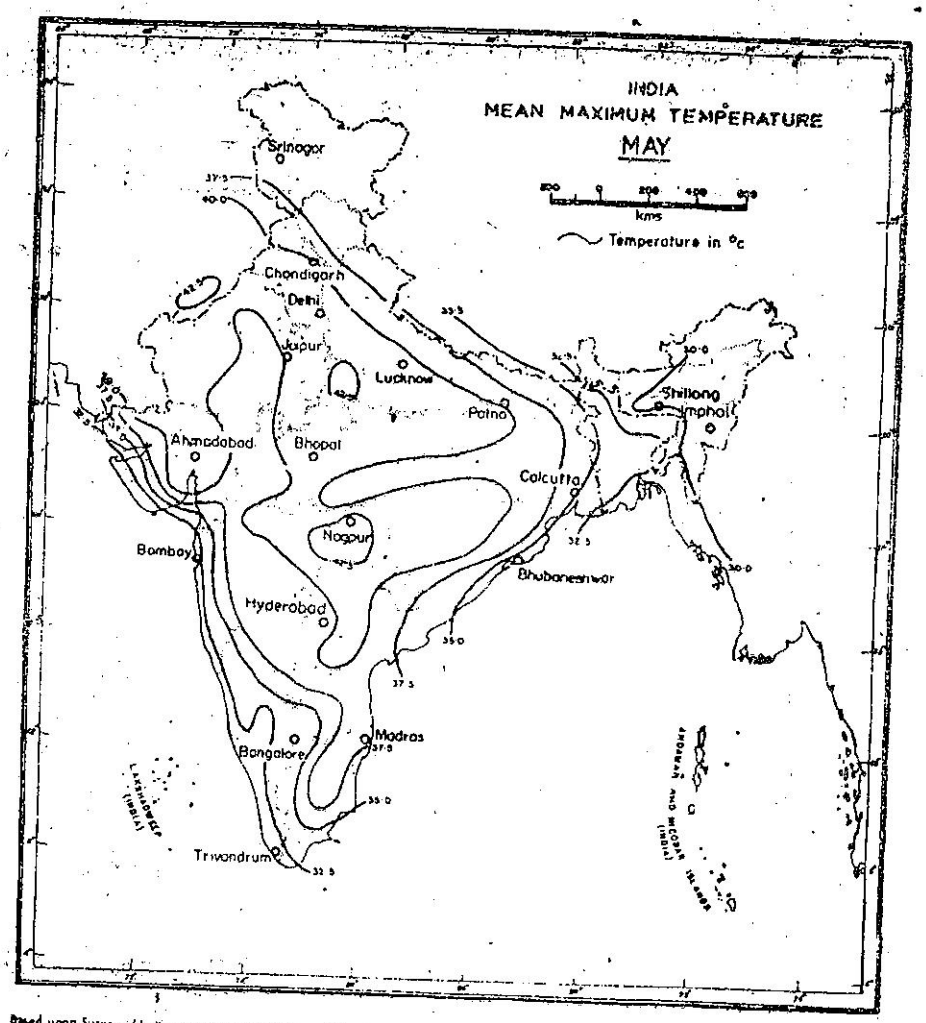


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Fig. 2.3 Mean Maximum Temperature (May)

Note the areas with the highest mean maximum temperatures. In which area do you notice the steepest gradient of heat? How will you explain this?

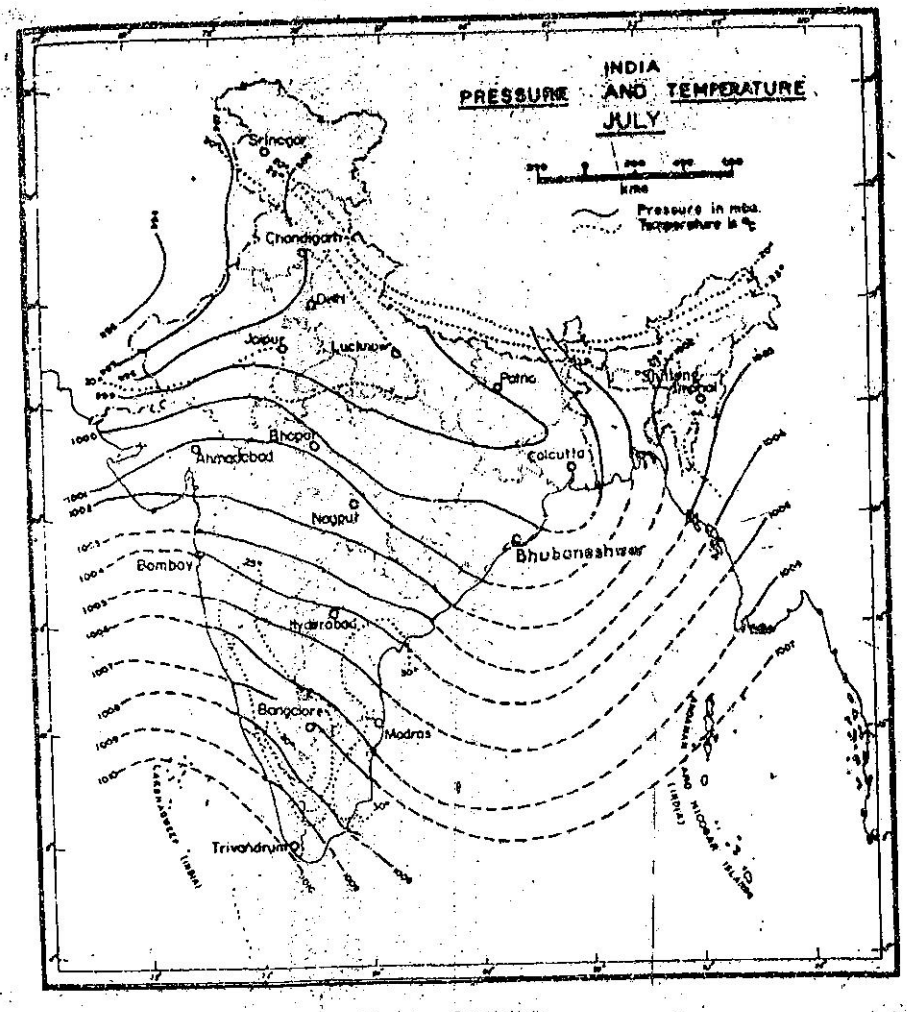

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Fig. 2.4 Mean Pressure and Temperature (July)

Compare this map with Fig. 2.3. 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?

parallel 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. And 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 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 and lightening. 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 NW 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 north-east causing widespread rains in the North-eastern 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 register 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 main land. 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

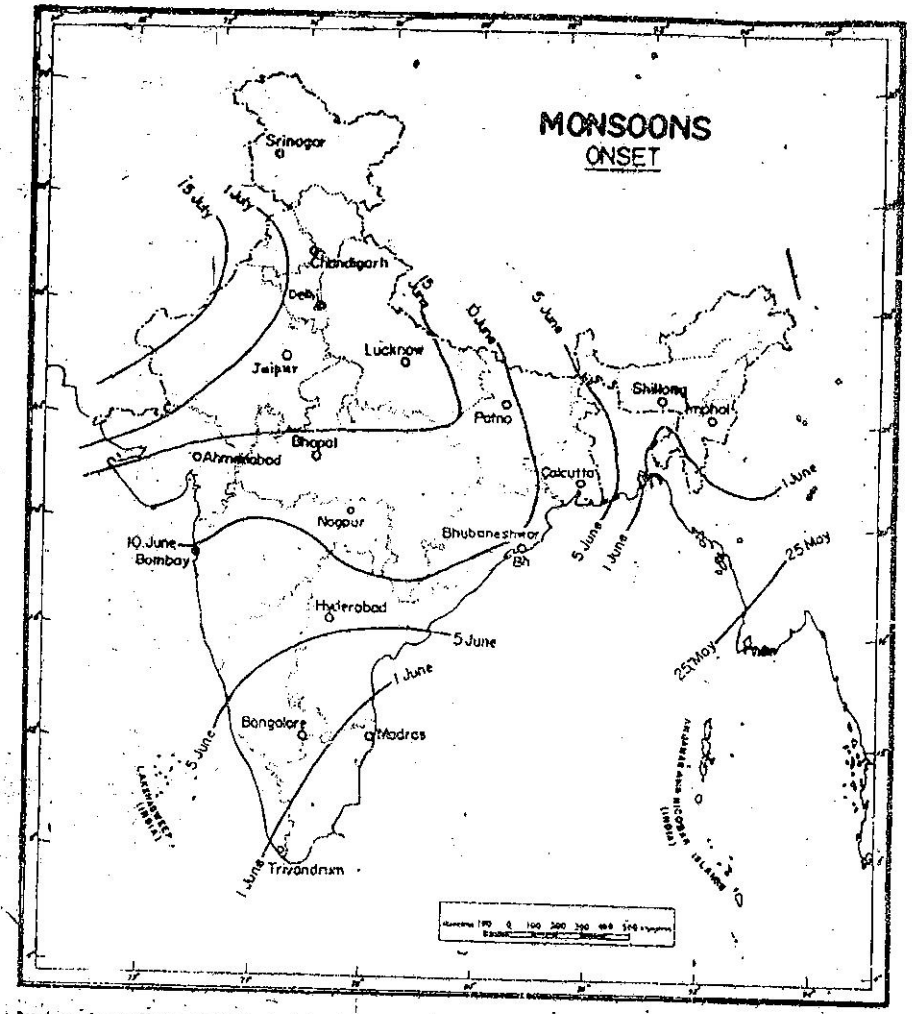

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Fig. 2.5(a) India—The Normal Dates for the Onset and the Withdrawal of the Monsoons

Compare the two maps and find out the duration of the south-west monsoon rainy season in Punjab, Assam, Kerala, Gujarat and the coastal areas of Tamil Nadu.

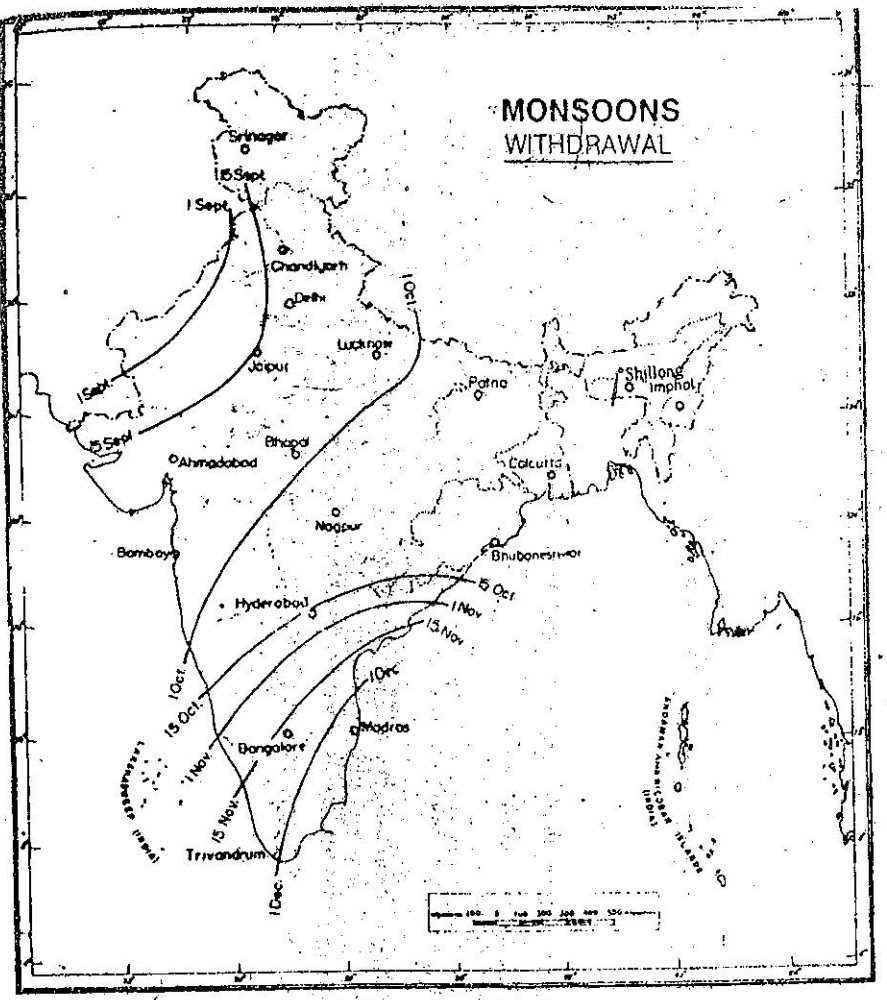

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Fig. 2.5(b) Normal Dates of the Onset and Withdrawal of the Monsoons

Compare the two maps 2.5 (a) and 2.5 (b) and find out the duration of south-west monsoon rainy season in Punjab, Assam, Kerala, Gujarat and the coastal areas of Tamil Nadu.

...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.

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. Then they are often found irregular and unpunctual in their advent 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 low pressure trough 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. The direction of surface winds starts reversing. 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 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 Sudarbans and Bangladesh too. Bulk of the rainfall of the Coromandel coast is derived from depressions and cyclones.

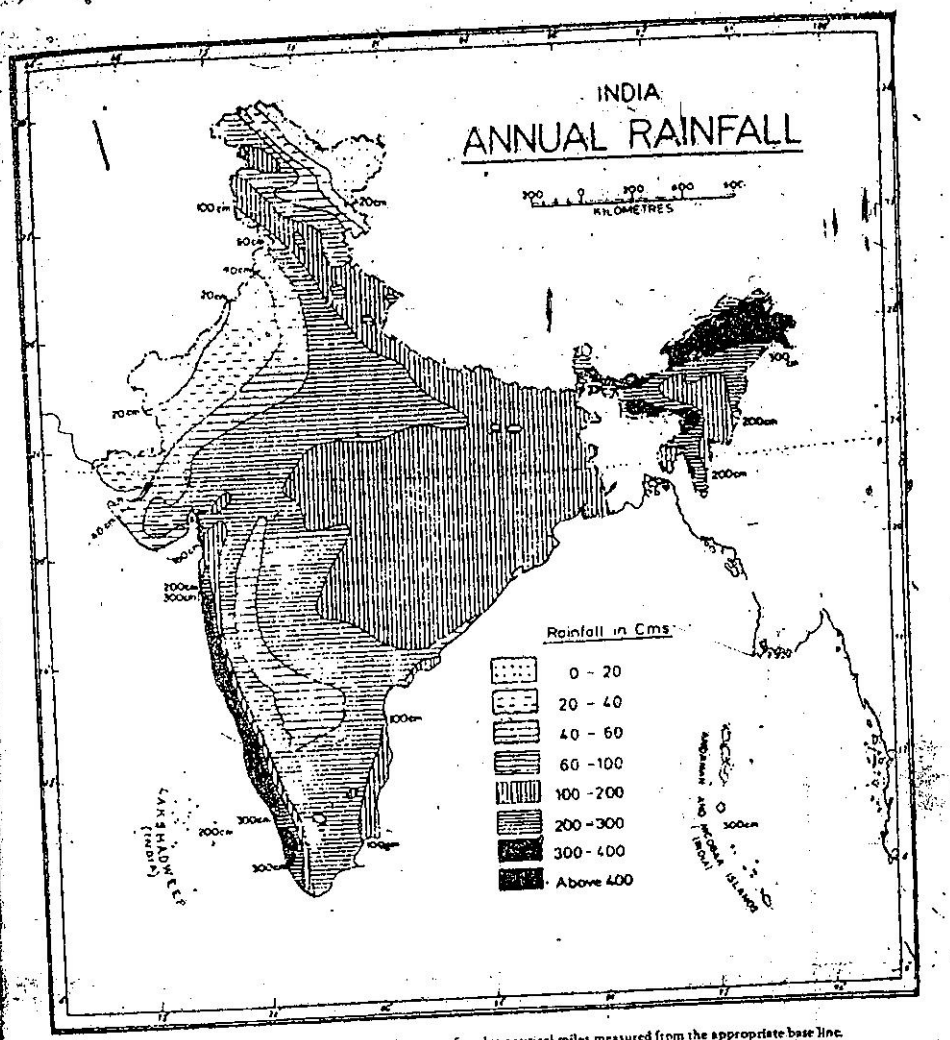
Distribution of Precipitation

Annual rainfall of over 300 cm is received over parts of western coast and north-eastern 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 the region 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.

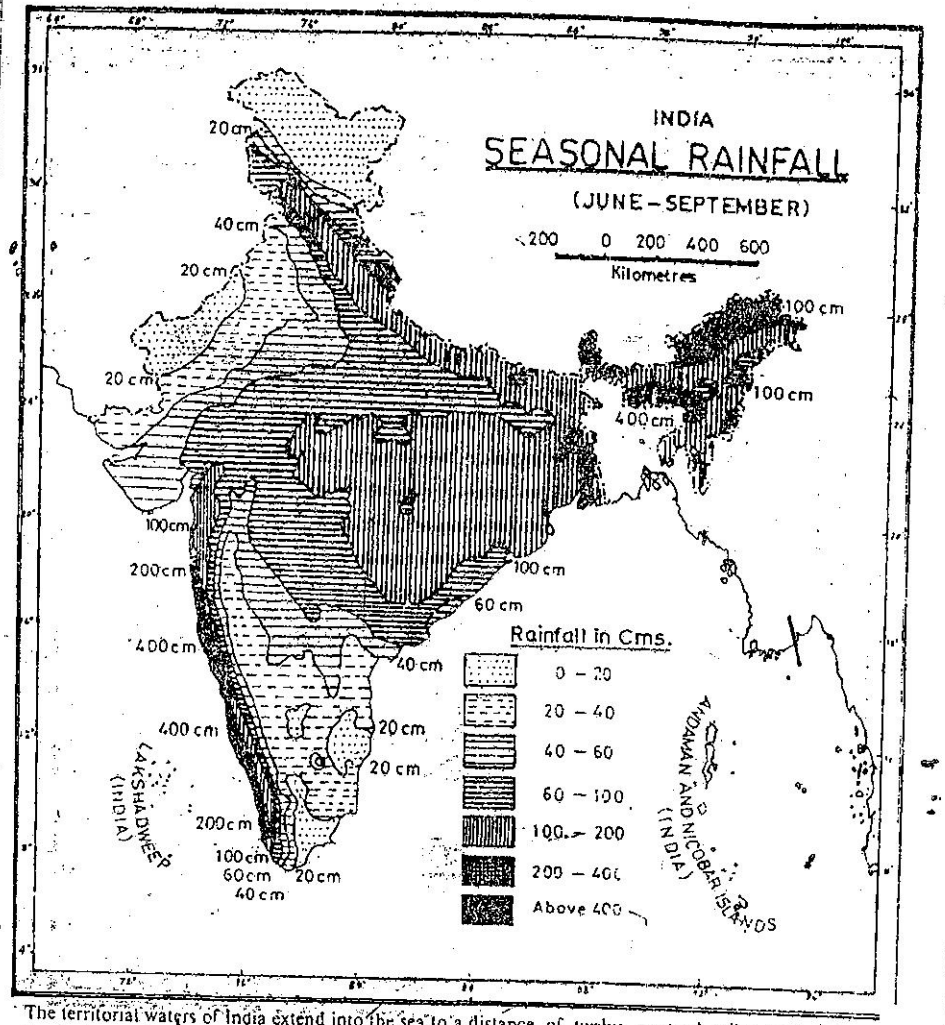
Monsoons as a Unifying Bond

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 temperatures for their latitudes. Despite



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

Fig. 2.6 India—Average Annual Rainfall
Note the areas of high, medium and low rainfall.



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

Fig. 2.7 India—Seasonal Rainfall (June to September)

Compare Figs. 2.6 and 2.7 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.

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 calendar and the total life of the Indian people, not excluding their festivities, revolve.

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 Cherrapunji 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 grows 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 eco-system, 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 and communications.

CHAPTER 3

The Flora, 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 plant kingdom. It was the plant kingdom that prepared stage for the appearance of another kind of life — the animal kingdom. 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 life 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 5,000 years of farming, all that human beings have been able to do is to select plants, sow seeds, and help their growth, and store them for a rainy day. They themselves cannot manufacture food as the plants do.

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.
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. 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.

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 fraught 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

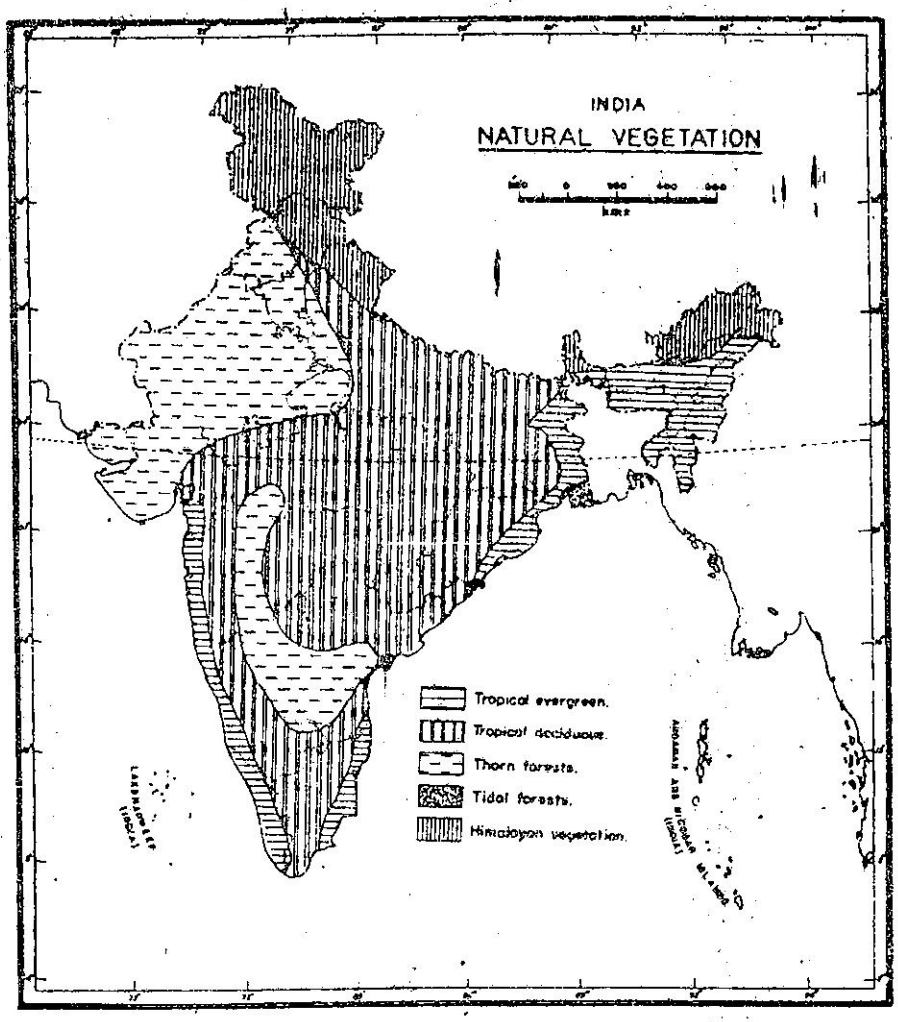
Climatic conditions, natural vegetation and soils are very closely interconnected. All over India, the original natural vegetation cover consisted of forest, grassland and scrub. It is estimated that our country possesses about 45,000 different species of plants. This represents the widest range for any country of the world of its size. Nearly 5,000 of the 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 range from the one found in the tropical zone to that of the Arctic zone.

Vegetation Regions

Barring the Himalayan region, country 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, as the region is warm and wet throughout the year. They are evergreen. The evergreen forests 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. Under these circumstances trees grow very vigorously, reaching heights of 60 metres and even more. The number of species is too large and too mixed to exploit each one of them commercially. Some of the commercially useful trees in 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. Subdivided into two they are: (i) moist,



Based upon Survey of India map with the permission of the Surveyor General of India.
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 Areas (Reorganisation) Act, 1971, but has yet to be verified.

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.

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 Chotanagpur 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. It spreads over north-western part of the country from Saurashtra in the south to Punjab plains in the north. In the east it stretches 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 a common feature. These forests gradually fade away into scrubs and thorny bushes. They 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 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. We notice in mountainous regions a succession of natural vegetation belts from tropical to the tundra region, all 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 Himalayas, are clothed with tropical moist deciduous flora. Sal is the most dominant and economically important species. Bamboo trees are also common in this belt.

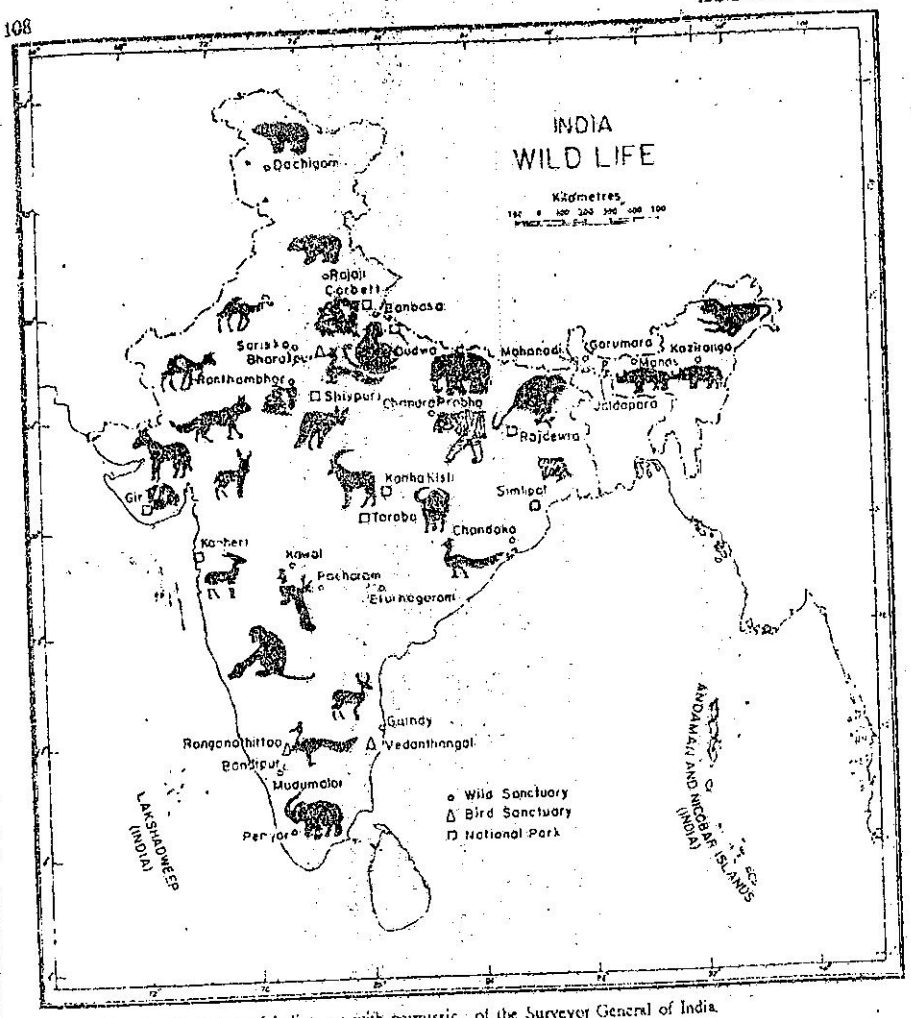
It is then succeeded by wet hill forest between 1,000 and 2,000 metres above sea level. Evergreen broad leave oaks, chestnuts and apples are common trees. Other trees to be found are ash and beech. At this altitude in north-eastern hills, where it rains heavily, there are sub-tropical pine forests in which chir or chil trees dominate.

Further up i.e. between 1,600 and 3,300 metres above sea level, pine, cedar, silver fir and spruce are some of the more important species. These are the well-known coniferous forests of the temperate region. In the inner Himalayan ranges and in drier climates these trees along with deodar are more at home.

Temperate coniferous forests yield place to Alpine forests generally at 3,600 metres above sea level. They consist of silver firs, pines, birches and junipers. Alpine forests give way to Alpine grasslands through shrubs and scrub.

OUR VARIED FAUNA

With an extremely wide variety of flora, our fauna are found to be equally rich and varied. There are about 75,000 known species.



Based upon survey of India map with permission of the Surveyor General of India.
© Government of India copyright. 1985.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

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

The country in its fresh and marine waters has as many as 2,500 species of fish. Likewise, there are about 2,000 species of birds. In addition there are amphibians, reptiles, mammals and small insects and worms.

Among the *mammals* we have the stately animal, the elephant. It is typical of hot wet equatorial forests and is found in the jungles of Assam and those of Kerala and Karnataka where it rains heavily and the forests are very dense. On the other hand, camels and wild asses belong to extremely hot and arid deserts. While the camels are common to the Thar Desert, the wild asses are confined to the arid areas of the Rann of Kachchh. Perhaps diametrically opposite is the habitat of the one-horned rhinoceros. They live in swampy and marshy lands of Assam and north-west Bengal. Yet another group of Indian animals consist of the Indian bison, the Indian buffalo and the nilgai. Among the most nimble and handsome animals a mention must be made of chousingha (four horned antelope), black buck (Indian antelope), gazel and deer. The species of deer include Kashmir stag, swamp deer, spotted deer, musk deer and mouse deer.

Among the *animals of prey*, the Indian lion distinguishes itself as the only species found anywhere in the world — barring the African continent. Its natural habitat is confined to the Gir forests of Saurashtra in Gujarat. Efforts are being made to acclimatise it to other parts of India with somewhat similar climate. If lion is the most majestic of all the animals, the tiger is one of the most powerful species in our jungles. The famous Bengal tiger has its natural habitat in the Sundarbans in the tidal forests occupying the edge of the Ganga delta. The other animals belonging to the cat family are leopards, clouded leopards and snow leopards. The latter are confined to upper reaches of the Himalayas

The Himalayan ranges are the home of several interesting animals. Important among them are wild sheep, mountain goats, the ibex, the shrew and the tapir. The lesser panda and the snow leopard are confined only to the upper reaches.

India has several species of monkeys. The langur is the most common among them. The lion tailed macaque has hair around the face which appears like a halo.

Bird life in India is both rich and colourful. If tiger is the national animal, the peacock is our national bird. Pheasants, geese, ducks, mynahs, parakeets, pigeons cranes, hornbills and sunbirds belong to the forests and wet lands.

Special efforts are being made to preserve *endangered species* of wild life—birds and animals. Periodic censuses are undertaken to find out the latest position and trends in this regard. Project tiger has been a great success. Now there are 16 tiger reserves in various parts of the country. Likewise, a rhino project is being implemented in Assam. The Indian bustard of Rajasthan and Malwa is yet another endangered species. Even the numbers of the lion had been dwindling for a long.

Steps have been taken for the protection and conservation of the great biological diversity of our land. Under this scheme the first *biosphere reserve* has been set up in the Nilgiri. It consists of 5,500 sq.km, and is spread at the trijunction of Karnataka, Tamil Nadu and Kerala. It came into being in 1986. Every plant and animal species would be protected so that this natural heritage can be transmitted to the future generations in all its natural vigour and glory. There are thirteen such zones to be reserved in toto.

After Nilgiri biosphere reserve, the one at Nanda Devi in U.P. Himalayas was set up in 1988. Likewise, Nokrek in Meghalaya was the third to be set up the same year. The

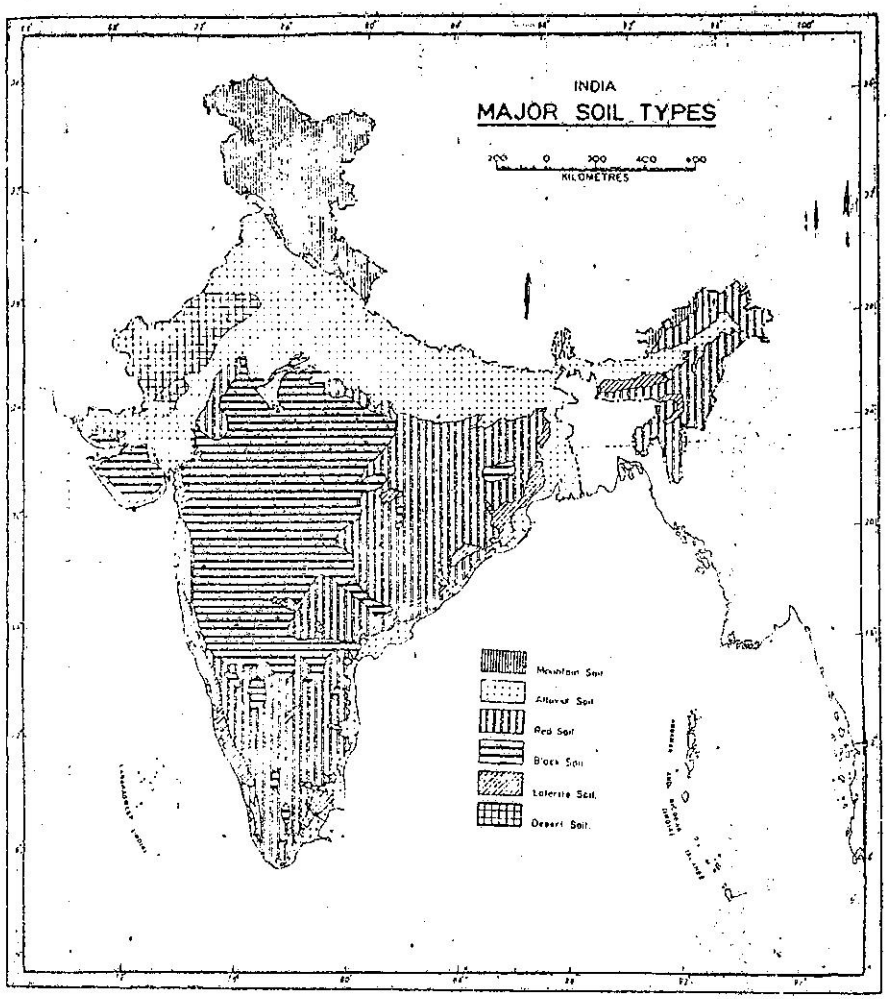


Fig. 3.3 India—Major Soil Types

Note the major soil belts in India. Do you notice any correlation between the major physical divisions and the different soil belts?

fourth one is in Andaman and Great Nicobar Islands to preserve submarine flora and fauna which is very diverse and unique. These biosphere reserves would cover very diverse climatic and vegetational zones, such as Eastern Himalayas in Arunachal Pradesh, Valley of Flowers in the hills of west U.P., Gulf of Mannar in Tamil Nadu, Thar Desert in Rajasthan, the Rann of Kachchh in Gujarat and Kaziranga and Manas parks—the home-land of rhinoceros in Assam. In each biosphere reserve the core will preserve wildland, the flora and the fauna in their natural forms. The surrounding zone would be utilized for research and experimentation in developing forest and other products, and the periphery for agricultural research and experimentation.

The country has 63 national parks, 358 wild life sanctuaries, and 35 zoological gardens covering 130.000 sq. km.

SOIL RESOURCES

The soil on which we depend so much for our survival has evolved over thousands and thousands of years. Soils are derived from parent rock material through the process of break-up, wear and tear. Various forces of nature such as changing temperature, running water and wind etc contribute in the evolution of soil. Chemical and organic changes which take place in the soil layer are equally important. Fine vegetal and animal remains add to the fertility of the soil.

Types of Soil

Indian soils are generally divided into four broad types. These soil types are :(i) alluvial soils; (ii) regur soils; (iii) red soils and (iv) laterite soils.

ALLUVIAL SOILS: This is the most important and widespread category. It covers forty per cent of the land area. In fact the entire Northern Plains are made up of these soils. They have been brought down and deposited by three great Himalayan rivers—Satluj, Ganga and Brahmaputra — and their tributaries. Through a narrow corridor in Rajasthan they extend into the plains of Gujarat. They are common in eastern coastal plains, particularly in the deltas of Mahanadi, Godavari, Krishna and Kaveri.

Towards the end of their long journey spread over hundreds of kilometres and thousands of years, very fine particles of soil called alluvium get deposited in their plains. These soils consist of varying proportions of sand, silt and clay. They are predominant in coastal plains and deltas. As we move further inland in the river valleys, the soil particles appear somewhat bigger in size. In the upper reaches of the river valleys, i.e. near the place of their origin, the soils are more coarse. Soil particles are larger and far from uniform. Such soils are more common in piedmont plains, i.e. those that are near the foot of mountain hills.

Apart from the size of their grains or particles, soils are described according to their age as well. They are old alluvium and new alluvium. Remember that so called new alluvium may be even ten thousand years old! Locally the old alluvium is called *bangar*, and the new alluvium is called *khadar*. The old alluvium often contains kankar nodules, with calcium carbonates in sub soil. The new alluvium is more fertile than the old.

Alluvial soils as a whole are very fertile. Generally, they contain adequate potash, phosphoric acid and lime. However, they are deficient in organic and nitrogenous content. Soils in the drier areas are more alkaline. Alluvial soils support over half the Indian population.

REGUR SOILS: These soils are black in colour and are also known as black soils. Since they are ideal for growing cotton, they are also called cotton soils, in addition to their local nomenclature of regur soils. These soils are most typical of the Deccan trap (Basalt) region spread over north-west Deccan plateau and are made up of lava flows. They cover the plateaus of Maharashtra, Saurashtra, Malwa and southern Madhya Pradesh and extend eastwards in the south along the Godavari and Krishna Valleys. In their formation climatic conditions are as important as their parent rock materials. Hence they extend much beyond the lava plateau itself.

The black soils are made of extremely fine i.e. clayey material. They are well known for their capacity to hold moisture. In addition, they are rich in soil nutrients, such as calcium carbonate, magnesium carbonate, potash and lime. They are generally poor in phosphoric content. They develop deep cracks in the field during hot weather. This helps in their aeration. This soil is sticky and difficult to work unless tilled immediately after the first or pre-monsoon showers.

RED SOIL: Look at the map. You will notice that the north-western half of the peninsular block has been covered by the black soils and the remaining south-eastern half is covered by red soils of different shades of red and yellow. They have developed on old crystalline rocks under moderate to heavy rainfall conditions. They practically encircle the entire black soil region on all sides, and cover the eastern part of the peninsula comprising Chotanagpur plateau, Orissa, east 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.

LATERITE SOILS: The laterite soil 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 Chotanagpur 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 potentiality 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 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 ecosystem 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? Give two names.
2. Distinguish between:
   (i) Flora and fauna
   (ii) Regur soils and laterite soils.
3. Discuss the altitudinal zones of vegetation in the mountainous 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 soil found in India.
6. Write short notes 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.

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 92.5 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
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

It is then succeeded by wet hill forests between 1,000 and 2,000 metres above sea level. Evergreen broad leave oaks, chestnuts and apples are common trees. Other trees to be found are ash and beech. At this altitude in north-eastern hills, where it rains heavily, there are sub-tropical pine forests in which chir or chil trees dominate.

Further up i.e. between 1,600 and 3,300 metres above sea level, pine, cedar, silver fir and spruce are some of the more important species. These are the well known coniferous forests of the temperate region. In the inner Himalayan ranges and in drier climates these trees along with deodar are more at home.

Temperate coniferous forests yield place to Alpine forests generally at 3,600 metres above sea level. They consist of silver firs, pines, birches and junipers. Alpine forests give way to Alpine grasslands through shrubs and scrub.

OUR VARIED FAUNA

With an extremely wide variety of flora, our fauna are found to be equally rich and varied. There are about 81,000 known species. The country in its fresh and marine waters has as many as 2,500 species of fish. Likewise, there are about 1,200 species of birds. In addition there are amphibians, reptiles, mammals and small insects and worms.

Among the *mammals* we have the stately animal, the elephant. It is typical of hot wet equatorial forests. It is found in the jungles of Assam and those of Kerala and Karnataka where it rains heavily and the forests are very dense. On the other hand, camels and wild asses belong to extremely hot and arid deserts. While the camels are common to the Thar Desert, the wild asses are confined to the arid areas of the Rann of Kachchh. Perhaps diametrically opposite is the habitat of the one-horned rhinoceros. They live in swampy and marshy lands of Assam and West Bengal. Yet another group of Indian animals consist of the Indian bison, the Indian buffalo and the *nilgai*. Among the most nimble and handsome animals a mention must be made of chousingha (four horned antelope), black buck (Indian antelope), gazel and deer. The species of deer include Kashmir stag, swamp deer, spotted deer, musk deer and mouse deer.

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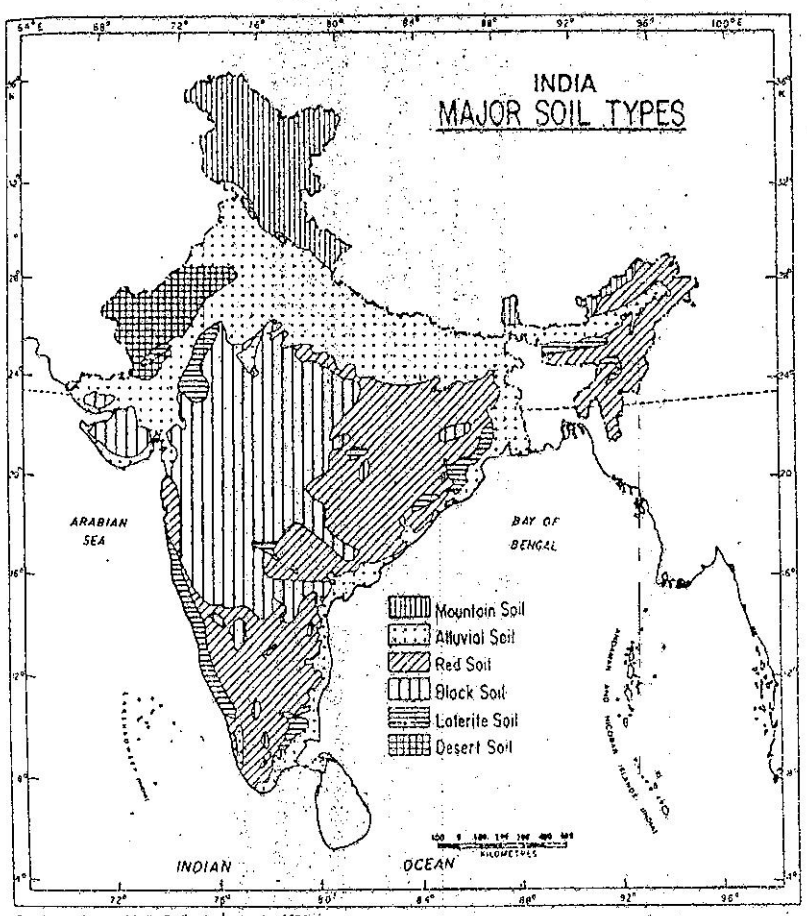


Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
Responsibility for correctness of internal details shown on this map rests with the publisher.

Fig. 3.3 India—Major Soil Types

Note the major soil belts in India. Do you notice any correlation between the major physical divisions and the different soil belts?

them. The lion tailed macaque has hair around the face which appears like a halo.

Bird life in India is both rich and colourful. If tiger is the national animal, the peacock is our national bird. Pheasants, geese, ducks, mynahs, parakeets, pigeons, cranes, hornbills and sunbirds belong to the forests and wet lands. What about the Indian cuckoo?

Special efforts are being made to preserve *endangered species of* wild life-birds and animals. Periodic censuses are undertaken to find out the latest position and trends in this regard. Project tiger has been a success. Now there are 16 tiger reserves in various parts of the country. Likewise, a rhino project is being implemented in Assam. The Indian bustard of Rajasthan and Malwa is yet another endangered species. Even the numbers of the lion had been dwindling for a long.

Steps have been taken for the protection and conservation of the great biological diversity of our land. Under this scheme the first biosphere reserve has been set up in the Nilgiri. It consists of 5,500 sq.km. and is spread at the trijunction of Karnataka, Tamil Nadu and Kerala. It came into being in 1986. Biosphere reserves are multi-purpose protected areas. Their major goal is to preserve the genetic diversity in the representative eco-systems. Besides Nilgiri the other biosphere reserves are (ii) Nanda Devi (Uttar Pradesh), (iii) Nokrek (Meghalaya), (iv) Great Nicobar; (v) Gulf of Mannar (Tamil Nadu), (vi) Manas (Assam), (vii) Sundarbans (West Bengal), (viii) Similipal (Orissa), and (ix) Dibru-Saikhova. In these bio-reserves every plant and animal species will be protected so that this natural heritage can be transmitted to future generations in all its natural vigour and glory. In each biosphere reserve the core will preserve wildland, the flora and the fauna in their natural forms. The surrounding zone would be utilized for research and experimentation in developing forest and other products, and the periphery for agricultural research and experimentation.

The country has 84 national parks, and 447 wild life sanctuaries covering 150,000 sq.km.

SOIL RESOURCES

The soil on which we depend so much for our survival has evolved over thousands and thousands of years. Soils are derived from parent rock material through the process of break-up, or wear and tear. Various forces of nature such as changing temperature, running water and wind etc. contribute in the evolution of soil. Chemical and organic changes which take place in the soil layer are equally important. Fine vegetal and animal remains, called humus, add to the fertility of the soil. Faulty agricultural practices, deforestation and overgrazing have led to soil erosion in many parts. The soil may be conserved by improved agricultural practices, afforestation and reducing pressure of grazing.

Types of Soil

Indian soils are generally divided into four broad types. These soil types are: (i) alluvial soils; (ii) regur soils; (iii) red soils, and (iv) laterite soils.

ALLUVIAL SOILS: This is the most important and widespread category. It covers forty per cent of the land area. In fact the

entire Northern Plains are made up of these soils. They have been brought down and deposited by three great Himalayan rivers—Satluj, Ganga and Brahmaputra—and their tributaries. Through a narrow corridor in Rajasthan they extend into the plains of Gujarat. They are common in eastern coastal plains, particles in the deltas of Mahanadi, Godavari, Krishna and Kaveri.

The river deposit very fine particles of soil called alluvium in their plains during the course of their long journey spread over hundreds of kilometres and thousands of years. These soils consist of varying proportions of sand, silt and clay. They are predominant in coastal plains and deltas. As we move further inland in the river valleys, the soil particles appear somewhat bigger in size. In the upper reaches of the river valleys, i.e. near the place of their origin, the soils are more coarse. Soil particles are larger and far from uniform. Such soils are more common in piedmont plains, i.e. those that are near the foot of mountain hills.

Apart from the size of their grains or particles, soils are described according to their age as well. They are old alluvium and new alluvium. Remember that so called new alluvium may be even ten thousand years old: Locally the old alluvium is called *bangar*, and the new alluvium is called *khadar*. The old alluvium often contains *kankar* nodules, with calcium carbonates in sub-soil. The new alluvium is more fertile than the old.

Alluvial soils as a whole are very fertile. Generally, they contain adequate potash, phosphoric acid and lime. However, they are deficient in organic and nitrogenous content. Soils in the drier areas are more alkaline. Alluvial soils support over half the Indian population.

REGUR SOILS: These soils are black in colour and are also known as black soils. Since they are ideal for growing cotton, they are also called cotton soils, in addition to their local nomenclature of regur soils. These soils are most typical of the Deccan trap (Basalt) region spread over north-west Deccan plateau and are made up of lava flows. They cover the plateaus of Maharashtra, Saurashtra, Malwa and southern Madhya Pradesh and extend eastwards in the south along the Godavari and Krishna Valleys. In their formation climatic conditions are as important as their parent rock materials. Hence they extend much beyond the lava plateau itself.

The black soils are made of extremely fine i.e. clayey material. They are well known for their capacity to hold moisture. In addition, they are rich in soil nutrients, such as calcium carbonate, magnesium carbonate, potash and lime. They are generally poor in phosphoric content. They develop deep cracks in the field during hot weather. This helps in their aeration. Hence their self-ploughing quality. This soil is sticky and difficult to work unless tilled immediately after the first or pre-monsoon showers.

RED SOIL: Look at the map. You will notice that the north-western half of the peninsular block has been covered by the black soils and the remaining south-eastern half is covered by red soils of different shades of red and yellow. They are developed on old crystalline rocks under moderate to heavy rainfall conditions. They practically encircle the entire black soil region on all sides, and

Table 6.2

Land Use (in percentage)

Name of the country	Cultivated area	Pasture land	Forested land	Waste land	Total
Canada	5	2	33	60	100
China	11	10	14	65	100
India	51	4	21	23	100
Japan	13	2	68	17	100
USA	20	25	28	26	100
USSR	10	13	42	35	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 latest land use figures, there has been a slight increase in the net sown area. Nearly 23 million hectares have been added over three decades. It constitutes 47.7 per cent of the total land area for which data are available. Another 1.3 per cent of the land is under fruit trees. Nearly 5 per cent of the land falls in the category of 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 a 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 large number of draught 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, atleast a third of the total land area must be kept under forests and natural vegetation. In India it is as low as 19.3 per cent.

The photographic evidence derived from the satellites has confirmed that only 46 million hectares are under real forests as against the 67 million hectares according to land use statistics. However, this figure shows a small rise from 40 million hectares to 46 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 claim becomes 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 not for only been able to extend the area under cultivation but also 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 places like Cherrapunji 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 parts of the country 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 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 metre.

Taking into account the average annual rainfall 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 only by 2010 A.D.

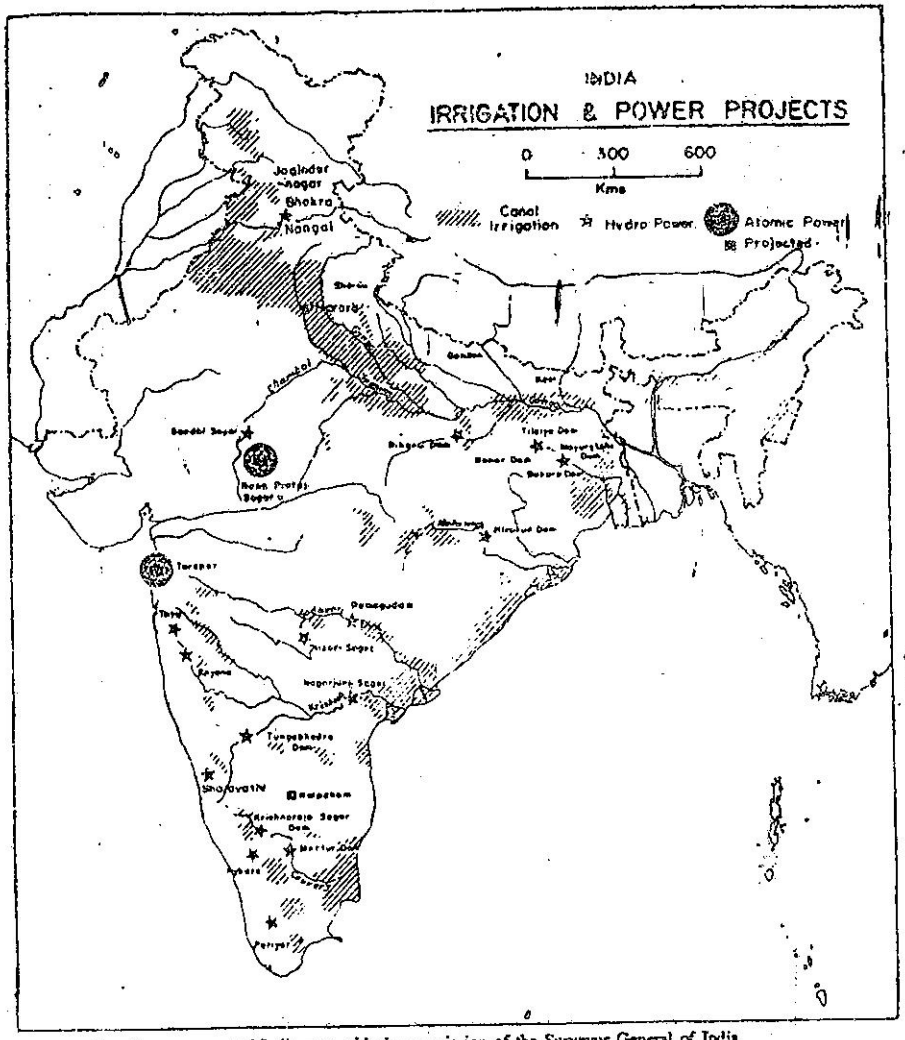
Before the commencement of the planning era i.e. in 1951 only 9.7 million hectare-metres of water was used for irrigation. By 1973, as much as 18.4 million hectare-metre of water was being used for irrigation.

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 80 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 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 a series of small dams are built on a river and its tributaries. In the first place these man-made lakes help in impounding huge amounts of



Based upon survey of India map with the permission of the Surveyor General of India.

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

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?

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 mankind. 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 in it. 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.

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 Chotanagpur in south Bihar to West Bengal. The Valley has the largest deposit of black gold i.e. coal. Iron ore depos its 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 has been integrated in 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 of West Bengal. The project irrigates half a million hectares of land in West Bengal and parts of south-east Bihar.

The Bhakra Nangal Project is an example of water management on scientific lines on the largest scale. The Bhakra Dam has been built at a strategic point where two hills on either side of the Satluj are very close to each other. The dam, therefore, is not very wide. It is the highest gravity dam in the world. Its height is 226 metres from the river bed. It is located in the seismic zone, and the hills that act as huge natural walls for storing 7,80,000 hectare-metres of water are made up of unconsolidated matter. Being very weak and brittle, the hills had to be strengthened by injecting them with big concrete blocks at regular intervals. The man-made lake Gobind Sagar is in Himachal Pradesh and has been named after Guru Govind Singh, the tenth Guru of the Sikhs. The canals taken out are 1,100 kilometres long. The distributaries are 3,400 kilometres in length. It irrigates an area of 1.4 million hectares. The Nangal power plant on the Satluj produces 1204 mw of electricity each year. The project serves the states of Himachal Pradesh, Punjab, Haryana, Rajasthan and the National Capital Territory.

Indira Gandhi (Rajasthan Canal) Project is an ambitious scheme to bring new areas under irrigation so that new areas could be cultivated. The waters of the Beas and the Ravi had to be diverted to the Satluj. The Pong Dam on the Beas has been constructed. It impounds 6,90,000 hectare-metres of water. It has helped to divert Beas water into the Satluj in a regulated manner so that Rajasthan Canal, the longest irrigation canal in the world, can irrigate Ganganagar, Bikaner and Jaisalmer districts of north-west Rajasthan. The main canal now called Indira Gandhi 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 a 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. It 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, former USSR, 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.

In spite of advantages like annual renewal and freedom from pollution, hydel power resources have not yet been sufficiently tapped. The initial cost of developing hydroelectric resources is very high.

At the time of Independence the total installed water power capacity was 5,75,000 kw. In the year 1986-87 alone a 19,20,000 kw of installed capacity was added. This would give you an idea of the tempo with which the demand and development have been growing. By 1986-87 the total installed capacity of water power had risen to 1,66,81,000 kw. In other words we have developed so far 40 per cent of our total hydel power potential

Major Water Power 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 Bombay. 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 man-made 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 Bombay-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 Karanataka 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 bought by India for its use in the north-eastern parts of the country including West Bengal.

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) Why 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.

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, she 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.

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 a 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.

TABLE 5.1

Production of Coal in India

Year	*Total (million tonnes)*
1965-66	67.73
1970-71	72.95
1975-76	99.68
1980-81	113.91
1985-86	154.20
1987-88	179.75

Draw your inference about the trend in the production of coal.

3. Study Table 5.2 and work out the percentage growth in the production of (a) coal, (b) petroleum, (c) bauxite, and (d) iron ore.

TABLE 5.2

Minerals Production Trends 1951-1987

Fuels	*1951*	*1987*
(i) Coal (million tonnes)	35	175.6
(ii) Natural Gas (million cubic metres)	Nil	6,519
(iii) Petroleum (million tonnes)	0.27	30.8
(iv) Bauxite (thousand tonnes)	68	2,685
(v) Iron-ore	3,700	51,989

4. Study Table 5.3 carefully.

TABLE 5.3

(A) *Total Plan Outlay in per cent in Energy Sector*

First Plan	10.4 per cent
Seventh Plan	30.46 per cent

(B) *Installed Capacity in Public Utilities*

	1947	1988-89
Installed Capacity	1360 mw.	59,132 mw
1988-89		
(a) Thermal	39,770 mw	
(b) Hydel	17,797 mw.	
(c) Nuclear	1,565 mw.	
Total	59,132 mw	

Bulk of the thermal power is coal-based with only 9000 mw from natural gas.

(C) Even with a steady rise in installed capacity, the actual production falls short by at least 10,000 mw at any time. This is because the demand simply keeps on zooming.

(D) Per capita consumption of electricity:

India	1947	17 kwh.
	1988	167 kwh.
USA	"	10,000 kwh
Sweden	"	12,000 kwh

(i) Find out why a very high priority is attached to the production of electricity.

(ii) Work out the percentages contributed by thermal, hydel and nuclear sectors in total installed capacity.

(iii) Compare our per capita consumption of electricity with the USA and Sweden and draw your own inference.

5. Study Table 5.4

TABLE 5.4

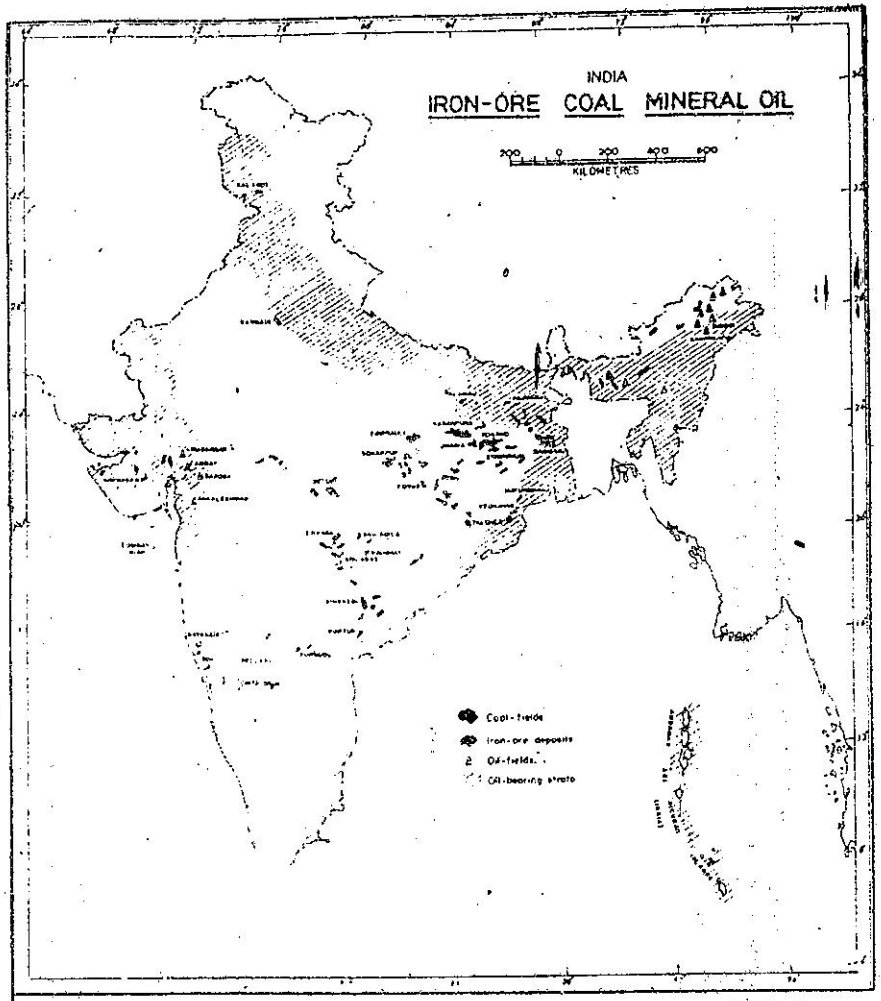
Consumption Pattern of Electricity (1950-1980)

Sector	*1950-51*	*1979-80*
Domestic	12.6	10.2
Commercial	7.8	6.0
Industry	62.6	60.6
Agriculture	3.9	15.4
Others	13.4	7.8

By March 1986 the number of pump sets/tube-wells energised rose to 6.15 millions. It further rose to 6.47 million by March 1987.

(i) Find out which sector has increased its demand for power over the past 30 years.

(ii) Draw your inferences about this growing demand of the sector concerned.



The topographical details within India are based upon Survey of India maps with the permission of the Surveyor General of India, the Copyright 1966 of which vests with the Government of India.

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

Fig. 5.1 India—Iron Ore, Coal and Mineral Oil

Note the high concentration of minerals in South Bihar and in the adjoining parts of Orissa and Madhya Pradesh. Why is Damodar Valley called the 'Ruhr of India'? What correlation do you find between the distribution of minerals and the geological structure of India?

The iron content of the ore is as high as 60 to 70 per cent. This explains the big international demand for our iron ore. The official estimates of the proven reserves are 17,570 million tonnes. These estimates are on the conservative side. Half of these deposits are confined to the districts of Singhbhum in Bihar and adjoining districts of Keonjhar, Bonai and Mayurbhanj in Orissa. It is perhaps the world's largest and richest iron ore field.

Iron ore is also mined in Hazaribagh, and Shahabad districts of Bihar.

Bihar-Orissa iron fields further extend into Raipur, Durg and Bastar in Madhya Pradesh. The mines in Bailadila in Bastar have been lately developed to step up exports to countries like Japan. Madhya Pradesh ranks now next only to Bihar and Orissa in mining iron ore.

The iron ore deposits are also found in several districts of Andhra Pradesh. In Tamil Nadu deposits have been located in Salem and Tiruchirapalli districts. Karnataka has its iron ore deposits in the districts of Chikmaglur, Chitaldurg and Bellari. The state of Goa has also iron ore deposits, although of not very high quality. They are largely exported. Ratnagiri and Chanda districts of Maharashtra have some iron ore deposits.

The production of iron ore has been steadily rising. It stood at 51 million tonnes in 1987. In 1951 it was less than 4 million tonnes. Unfortunately major portion is mined for export rather than manufacture of iron and steel in our own country. The ports specialising in the export of iron ore are Visakhapatnam (for Bailadila mines). Marma Goa, Paradip and Calcutta. Mangalore is likely to emerge as an iron ore exporting port, as Kudremukh mines have been developed for this purpose.

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 mines of manganese ore are located in Mayurbhanj and Keonjhar in the state of Orissa. In Karnataka, the deposits are located in Chitradurga, Tumkur, Shimoga, Chikmaglur, Belgaum, Dharwar and North Kanara districts.

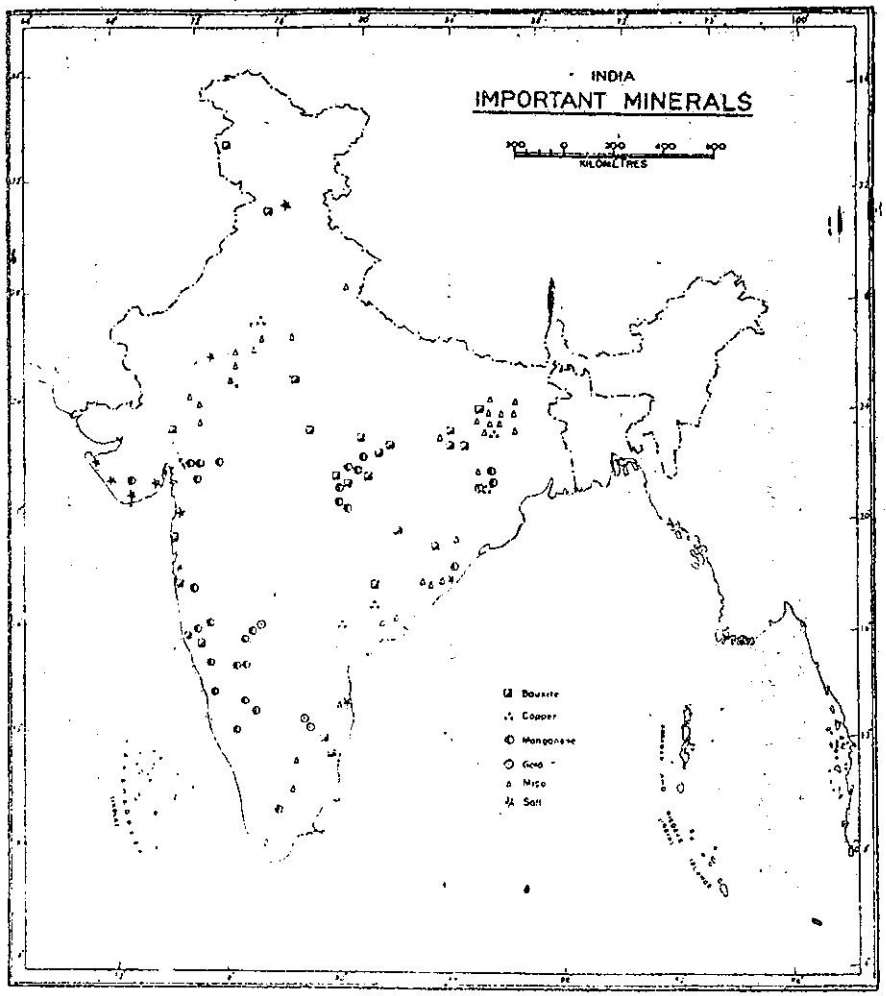
The other states in which manganese is found are Bihar (Singhbhum), Andhra Pradesh (Nizambad and Visakhapatnam) and in Rajasthan (Banswara and Udaipur).

The total production in 1987 was 1.3 million tonnes as against the conservative estimates of 135 million tonnes of total reserves. Of these at least 50 million tonnes are of high quality

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 electrical industry and also in everyday life. But the manufacture of alumina and aluminium depends largely on the availability of cheap and abundant supply of electricity.

The bauxite deposits in India are widely distributed. Traditionally Bihar, Gujarat and Madhya Pradesh have been the major producers. Maharashtra has also high grade deposits in Kolhapur district. 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.



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

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

Note the location of the various minerals in India. In spite of a long coastline the extraction of salt from sea water is confined to the Gujarat Coast only. Why should it be so?

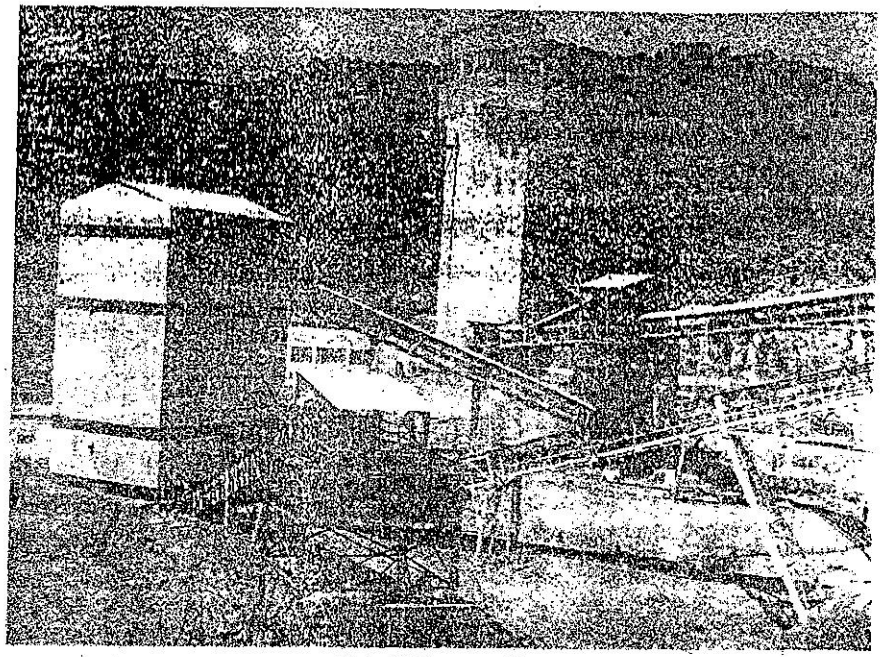


Photo III Ore-sorter Plant

This is a photograph of the ore-sorter plant at Khetri copper complex. Find out on your map where Khetri is located.

In 1987 the output of bauxite was 2.6 million tonnes. The country's reserves are estimated at 270 million tonnes, of which 73 million tonnes are of high quality.

Mica

India produces nearly 90 per cent of the world's mica. It is a basic ingredient of the electrical industry. India accounts for two-thirds of the world's mica entering into international trade. Annual production is about 30,000 tonnes. Half of it comes from Hazaribagh, Gaya and Munger districts of Bihar. These districts lie on the northern edge of Chotanagpur plateau. The remaining half is equally shared by Nellore district in Andhra Pradesh and Bhilwara District in Rajasthan. India faces competition from Brazil. It has been noticed that our ways of mining mica are rather wasteful.

Copper

Copper was widely used for making household utensils. In fact before the discovery of iron, copper held its way 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 reserves are estimated at about 570 million tonnes with only 6.3 million tonnes of copper content. The annual output of the ore in 1987 was nearly 5 million tonnes.

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 two mines in Anantpur and Chittoor districts of Andhra Pradesh have lately started functioning. The known reserves are placed at only 81,000 kg of gold content. The annual production of gold has been dwindling. It has come down from 7,000 kg in 1951 to 1931 kg in 1986.

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 sources 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. Among them the coal still occupies a prominent position.

Coal

Coal, besides being a prime source of industrial energy, is also a raw material. It is an indispensable input in steel and chemical industries. Coal, inclusive of lignite, even today accounts for 60 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 place names well associated with these deposits are Raniganj, Jharia, Giridih, Bokaro and Karanpura. The other river valleys associated with coal deposits are the Godavari, Mahanadi, Son and Wardha. Other coal mine areas are in the Satpura range and in Chhattisgarh 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 198 , have put the country's proven coal reserves at nearly 100 trillion tonnes, i.e. 15,92,99,160 million tonnes. These are based on the seams of 0.5 metre and above in thickness and only to a depth of 1200 metres. 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. Even its conversion into oil is not ruled out. 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 35 million tonnes in 1951 has now jumped to over 180 million tonnes by 1988-

89. Thus the per capita consumpuon of coal has increased from 135 kg to nearly 225 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. They constitute the country's 90 per cent of the lignite reserves. 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. Annual production in this largely open cast mine is 6.5 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 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 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 Bombay coast, 115 km from the shore. So far this has been the richest oil field 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 oil fields. But exclusive natural gas reserves have been located in Tripura, Rajasthan and almost in all the off-shore oil fields of Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh and Orissa.

Our Growing Oil Budget

In 1951 our total production of mineral oil was 269,000 tonnes. Our total consumption then was also very meagre as compared to what it is today. It stood at 3.1 million tonnes. By 1984-85 our production of natural oil jumped to 29 million tonnes. But our consumption too soared high to 39 million tonnes. The net imports were 7 million tonnes of crude and 5 million tonnes of petroleum products. The refineries crude throughput stood at 35 million tonnes.

In 1986-87 the oil production stood at 30.5 million tonnes and in 1988 it was nearly 36 million tonnes. It was only 10 million tonnes in 1980-81. The recoverable reserves of crude oil which were 366 million tonnes in 1980 rose to 580 million tonnes by 1987.

The production of *natural gas* stood at

2,358 million cubic metres in 1980-81. It rose to 9,812 million cubic metres by 1986-87. The total reserves of gas were estimated at 5,41,000 million cubic metres. 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 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.

There are already 12 refineries in the country. The Liquefied Petroleum Gas (L.P.G.), also called the cooking gas, is now being increasingly used as domestic fuel in urban areas. It is an efficient and clean fuel. It has succeeded in reducing demands on our shrinking forests, at least in urban areas.

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 man. 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 installed capacity to produce thermal power in 1988-89 was nearly 40 million kw. It was a little more than twice the capacity to produce hydel power. The actual power generated in 1988-89 was of the order of 201 billion units. As against this hydel power accounted for 53.8 billion units and 5 billion units of nuclear power. In a single year it had risen by about 10%.

Power stations, both big and small, are scattered all over the country. The electricity produced by them, however, is fed into regional grids to optimise their utilization. It is proposed to have a single national grid in course of time. The grid receives and distributes electricity produced from all the four major sources—coal, natural oil, water and atomic minerals. The total length of transmission lines was 10,000 circuit km in 1950. It rose to 1,71,000 circuit km in 1987. Besides these there are high voltage transmission lines of 400 kv strength. Their total length is 16,000 km and 55,855 km of 220 kv strength.

The power generating plants in India work at only 53 per cent plant load factor. Their functioning can be improved with due care.

Nuclear Power

India being 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 nucle-

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

India has four atomic power plants. They are at Tarapur on Maharashtra-Gujarat border on the Arabian Sea coast, at 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.

Non-conventional Sources of Energy

Regional and national integrated grids are an index of the growing popularity of a centralised distribution system. It also provides for feeding into a common distribution system, all the energy derived from various sources like coal, diesel, petroleum, natural gas, water and nuclear minerals. Major advantage in the centralised system is that deficient regions can lean heavily on energy surplus regions. More importantly, it can help tide over immediately any emergency situation when power system breaks down in a given area.

Centralised 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.

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

Today non-conventional sources of energy include wind, tides, geo-thermal heat, biomass, farm and animal waste including human excreta. All these sources are renewable or inexhaustible. They are inexpensive in nature.

Wind Energy

It can be used for pumping water, a prime need in irrigating farms in the countryside. Also, it can be used for generating electricity. It is estimated that wind alone can provide 2,000 mw of electricity. 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. There were 1750 wind mills till March, 1987. There were also five wind farms with installed capacity of 3.63 mw. They have already produced half a million units of energy and fed into the grid.

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.

Geo-Thermal Energy

India is not rich in this source. However, efforts are on to utilize natural energy of the

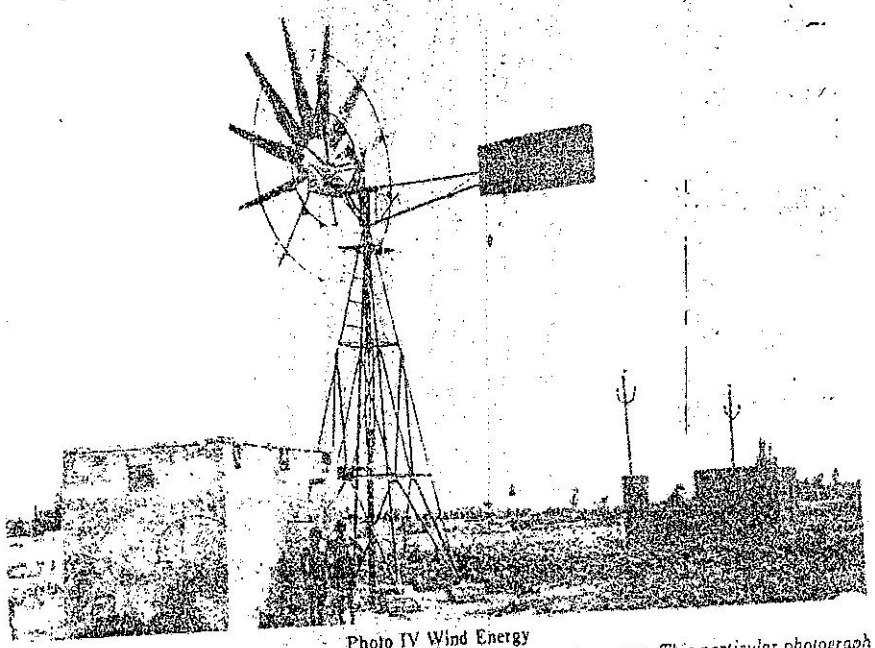


Photo IV Wind Energy

Non-conventional sources of energy such as wind can be used for several purposes. This particular photograph shows a wind mill in operation in a village. It is being used for lifting water for irrigation and drinking purposes

hot springs at Manikaran in Himachal Pradesh. Energy so produced can be used for running cold storage plants.

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 in 1987.

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.

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 like rice husk are also being used to produce electricity.

Farm Animal and Human Wastes (Urja Gram)

By using biomass, animal, poultry wastes and 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 generation of biogas.

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 3 million improved varieties of efficient and smokeless chulhas in operation till 1987. They help in saving firewood to the tune of 20 to 35 per cent. Nearly 2 million tonnes of fire wood is saved annually through these chulhas. They help in avoiding health hazards like sour eyes.

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. Over 70,000 solar cookers were in use till April, 1987. 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.

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? From what two specific limitations do they suffer?
   (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?
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 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.

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 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 changes 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 been almost tripled but it will have to be further tripled before the population can be hopefully expected to stabilise in the next six or seven 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 environ-

ment, 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, and air will have to be stopped at any cost. All our efforts will have to be permeated with a spirit of social justice ensuring equal opportunities for all. This is a must to accelerate the pace of our development.

CHAPTER 6

Agriculture

India is essentially an agricultural land. Indian society is an agrarian society. Agriculture has been the mainstay of its economy. Two-thirds 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 1985 to 1988 show that it has slided down to 33.7 per cent only. None the less, the importance of agriculture cannot be minimised for years to come, as it has the distinction of sustaining two-thirds of our population. 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.

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

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) Find out whether India's position appears so weak because of
(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.

(ii) Find out the level of inputs like fertilizers, technology, quality seeds, capital inputs and irrigation in a few countries and the way they compare with India (see Table No. 6.2)

TABLE 6.2

Agricultural Inputs in India 1950-51 to 1986-87

Item	*Unit*	*1950-51*	*60-61*	*70-71*	*80-81*	*86-87*
1. Production of Breed seeds	1000 Q/H	—	—	—	5.27	24.84
2. Production of certified seed	Lakh Q/H	—	—	—	21.86	56.5
3. Fertilizer consumption	Lakh tonnes	0.69	2.92	21.77	55.46	92.0
4. Fertilizer consumption per hectare	Kg	—	1.9	13.13	31.83	50.61
5. Area under H.Y.V. seeds	Lakh Kg	—	18.9	153.8	430.7	550.4
6. Cooperative credit	Crore Rs.	24.23	214.35	678.31	2126.31	3206.0

Q/H (Quintal per hectare.) HYV (High yielding varieties).
Compare the figures and analyse the trend under each items.

TABLE 6.3

Growth of Yield per Ha/ in Kg 1950-51 to 1985-86

	1950-51	*1970-71*	*1985-86*
1. Cereals	542	949	1332
(a) Rice	668	1123	1568
(b) Wheat	663	1307	2032
(c) Jowar	353	466	641
(d) Bajra	288	622	345
(e) Maize	547	1279	1172
2. Pulses	441	524	544
3. Food Grains	522	872	1184
4. Oil Seeds	481	579	591
5. Cotton Lint	88	106	193
6. Jute	1043	1186	1717

(i) List cereals in the order of their growth in yield.
(ii) Draw your inferences about pulses and oil seeds.

TABLE 6.4

Average Size of Agricultural Holdings in Some Countries

Country	*Year*	*Hectares*
Australia	1970	1992.58
Egypt	1960	1.59
France	1970	22.07
India	1970	2.3
Japan	1970	1.01
U.S.A.	1969	157.61
Zaire	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 is 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

TABLE 6.5

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

Size class (ha)	*No. (in million)*	*%*	*Area (in million hectares)*	*Percentage of the arable land*
(1) Below 0.5	23.28	32.9	5.44	3.9
(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	9.5	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	100

(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 below one hectare (Row Nos. 1 and 2) and for land-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.

TABLE 6.6

Some Facts about Green Revolution in India

(A) *Per capita Income* (1985-86) at 1970-71 prices
India - Rs. 779
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) Onethird of the country's tractors were in Punjab alone.
(b) Ploughing, sowing, threshing 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

[illegible]
[illegible] (almost two crops a year)

(I) *Wheat yield per hectare* (1985-86)
India = [illegible] kg
Punjab = [illegible] kg

(I) *Change in Size of Operational Land Holdings*
(a) holdings above 10 hectares each [illegible]
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) conversion of tenants — at will
(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.

Perhaps the greatest problem of Indian agriculture is the tremendous population pressure it has to groan under. With nearly 250 persons per square kilometre, the hunger for land has remained unsatisfiable. 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 mere 3.9 per cent 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 a poor farmer struggles day in and day out on a farm which is too small to support him and his family. Indian agriculture has, therefore,

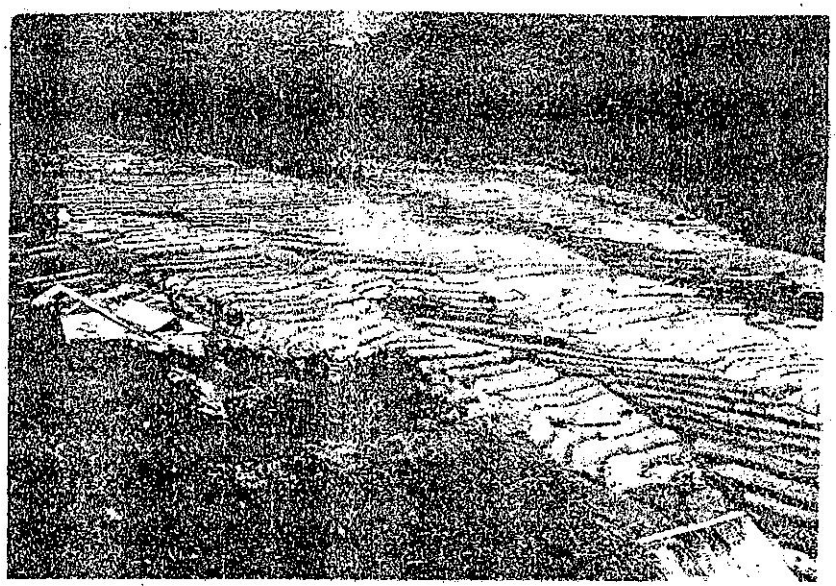
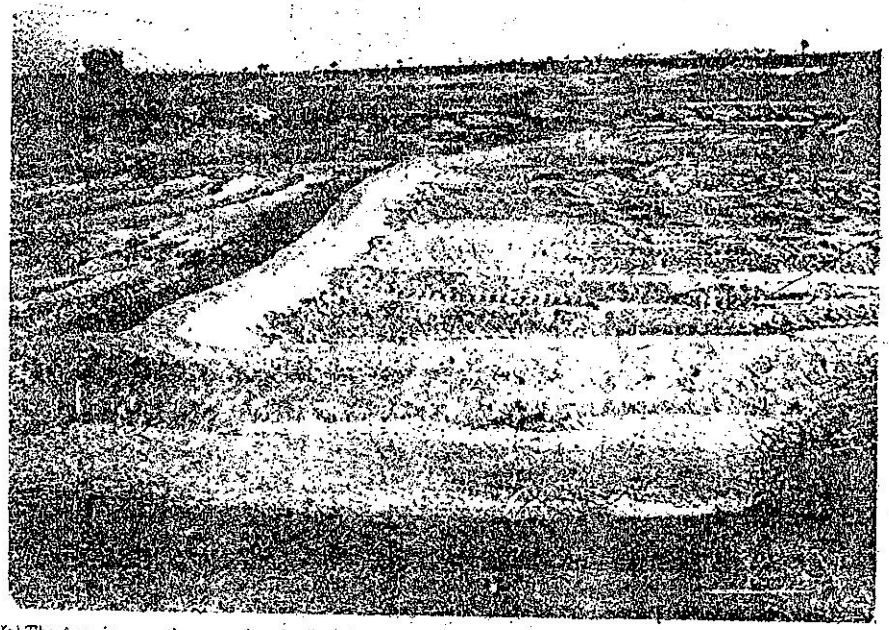


Photo V (a,b & c) Methods of Conserving Soil

(a) Terraced farming on hill slopes prevents soil from getting washed off with the running water

(b) Contour ploughing on hill slopes reduces erosion, run-off soil loss and increases production



(c) These ravines are the examples of soil erosion, which are being reclaimed and terraced to make the land fit for cultivation.

stagnated for decades.

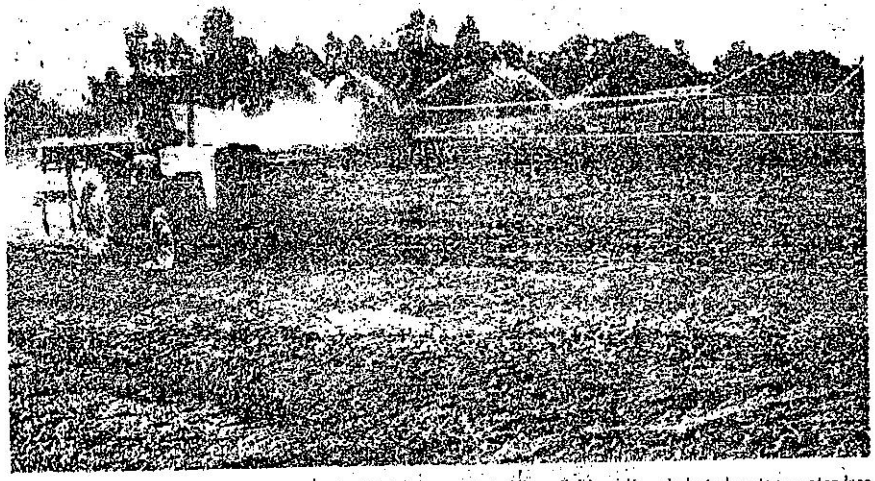
In the absence of adequate forest and pasture lands, the sources of maintaining natural fertility of the soil have been drying out. The lack of material resources and ignorance of scientific knowledge have only further depleted the soils of their natural fertility. There was a time when animal waste 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 co-operatively 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 make 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, fungi-

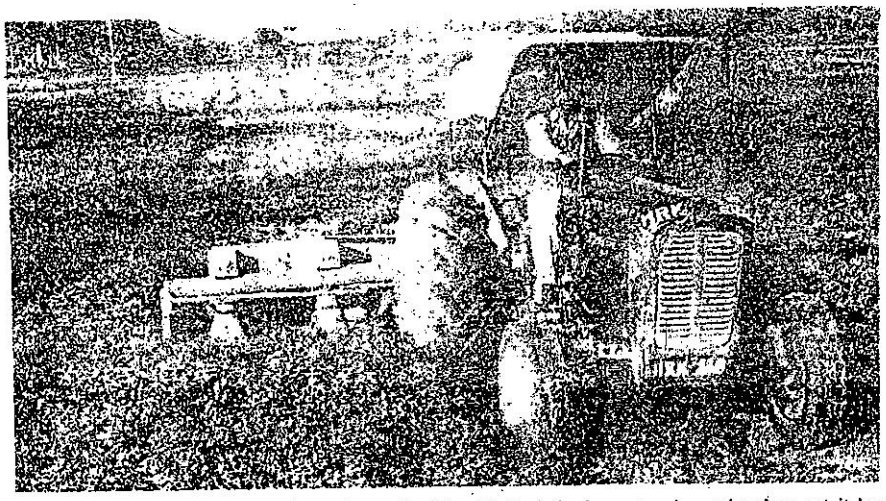
Photo VI Using Machines in Farm Operations

(a) For saving time, machines are increasingly being used in different kinds of farm operations even in medium sized farms. You can see in this photograph how the ground is being levelled with the help of a leveller attached with the tractor.



(b) You can see water sprinklers irrigating the field. It not only irrigates fields uniformly but also stops water loss.

(c) In this picture you can see a newly developed paddy transplanter being used by a farmer in Punjab.



(d) Look at the harvester in operation. The patch of land behind the harvester shows the clean cut it has made

cides 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 of 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) ploughing, sowing, weeding, spraying, irrigating, water sprinkling, harvesting, threshing, transporting 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 i.e. 17 million tonnes foodgrains, are 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 tripling its food production in the last forty years. Incidentally it coincides also with the tripling of our irrigated land. Nearly 28 per cent of the gross cultivated area has been brought under irrigation. Utilization of total irrigation potential can raise this percentage to about 44 by 2010 A.D. Thus land has already reached a stage of diminishing returns. Water, our only saviour, too is on its way to reach a saturation point. The inevitable law of diminishing returns would begin to operate sooner or later.

The governemt 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 now required to provide loans to farm rs 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 set up. 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

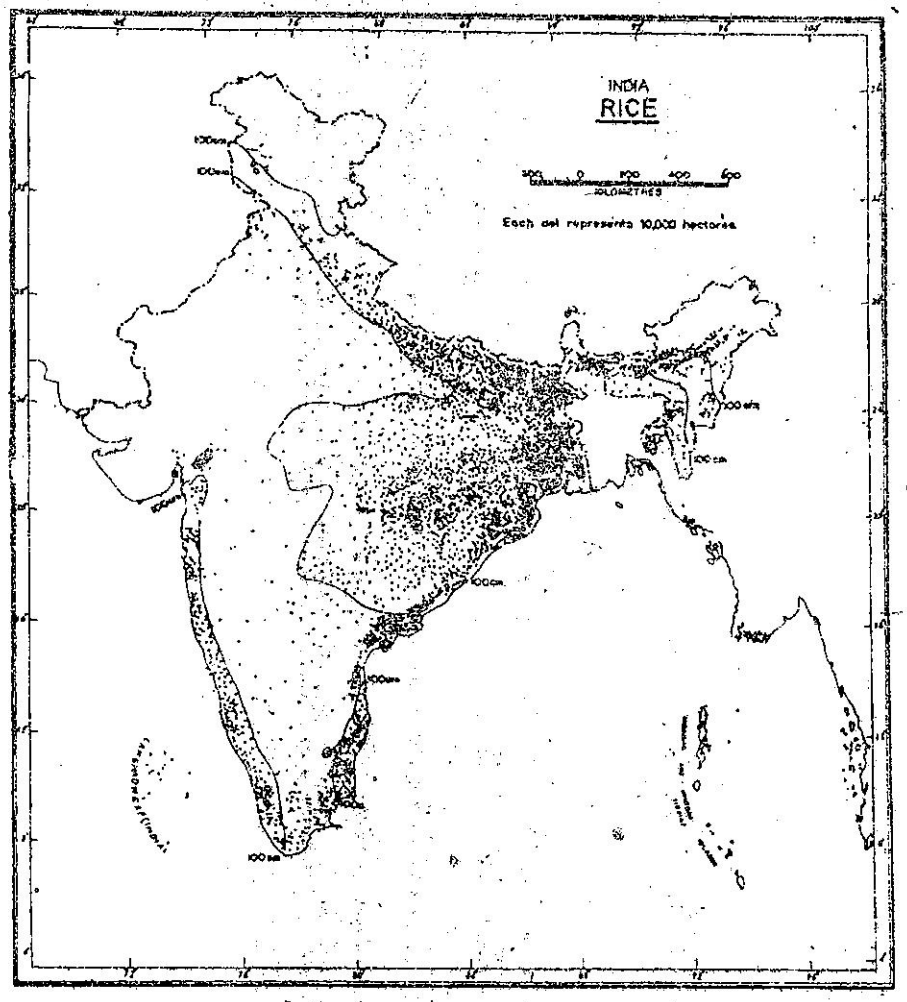


Fig. 6.1 India—Distribution of Rice

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.

been made in extending irrigation and electricity facilities for farm activities.

In spite of all these measures, there is a view that Indian agriculture deserves far greater attention, priority and resources if it is to grow quickly to its full potential. There is a feeling that rural and urban price levels are kept artificially at two different levels, where prices of agricultural produce are kept under strict control unlike other industrial products. 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 good of one and all. Social justice is the cry of the hour.

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.

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.

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, sugar-cane, 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 the *isohyet* on the map. It demarcates very clearly (i) the western coastal strip, (ii) the eastern coastal strip, covering all the major deltas, (iii) the north plains and low hills, (iv) foot hills 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. About 47 per cent of the total area under cereals is claimed by rice alone. In 1950-51 the area under rice cultivation was 30 million hectares. It has risen to 40 million hectares by 1985-86. During the same period the production of rice also rose from 25 million tonnes to 64 million tonnes. Thus the yield per hectare rose to 15.7 quintals, an increase of nearly two and a half times. Shall we overtake China in this regard?

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 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 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.

Photo VII Transplantion of Paddy

Paddy transplantation in a large part of the country is mainly done by hand. Hence it is time consuming and labour intensive process. Note the water logged fields and the way each plant is being planted in rows.

Wheat

The story of wheat is even more fascinating than that of rice. It is one of the oldest crop 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 1950-51 the area under wheat was 9.7 million hectares. By 1985-86 it rose to 23 million hectares. The production shot

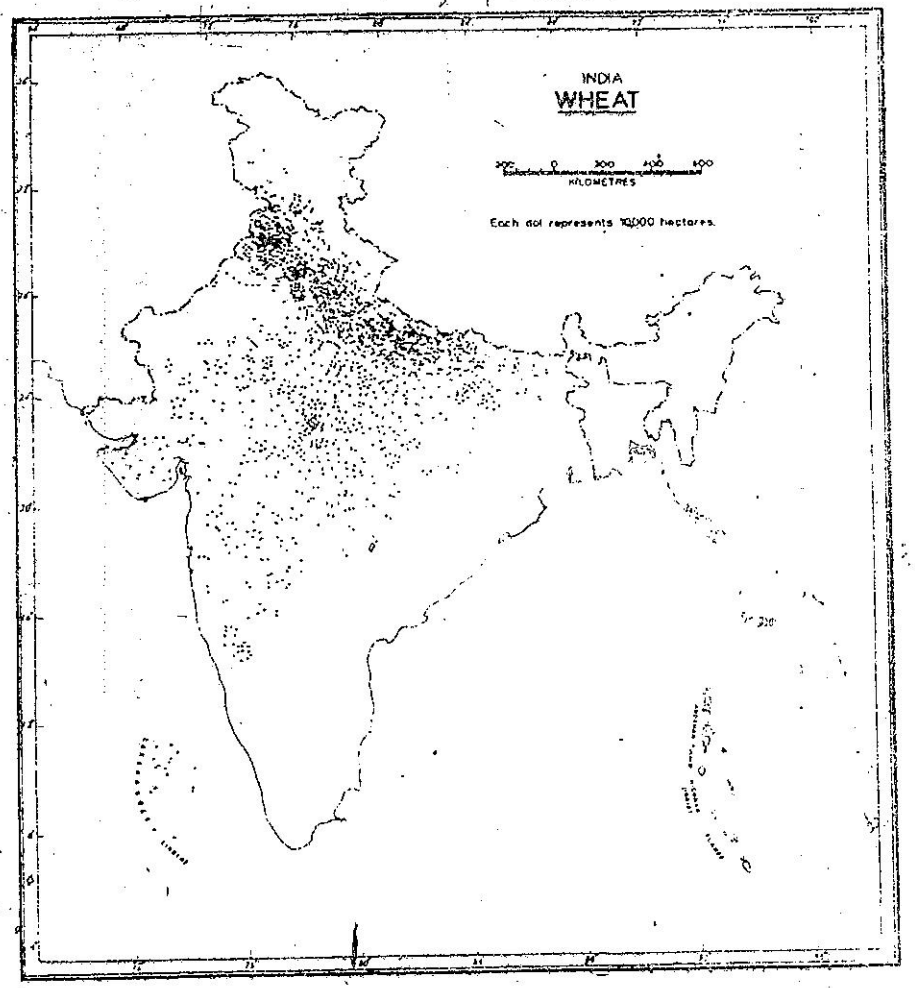


Fig. 6.2 India—Distribution of Wheat

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?

up to 46.9 million tonnes from mere 6.4 million tonnes. The yield per hectare has tripled during the same period from 6.6 quintals to 2 tonnes. In wheat production we have overtaken countries like Argentina, Australia, Turkey, France and Canada. We now stand next only to Soviet Union, the United States and China. In 1988-89 the production crossed 51 million mark.

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 rainy 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 a million tonnes to 14 million tonnes. Millets have a protein content higher than both wheat and rice.

Maize

Maize, being an American crop, is relatively a new entrant. 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 million hectares by 1985-86. The production has also jumped from less than 2 million tonnes to 7 million tonnes. Thus, the productivity has also doubled.

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 *(urd)* 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. Inter-culture 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 13 million tonnes with a marginal increase in yield from 4.4 quintals to 5.4 quintals per hectare.

One thing is clear from the facts mentioned above that the prospects of bringing more pulses within the reach of common man are bleak. The limitations of the so called Green Revolution are obvious. For heavy yielding varieties, assured irrigation and higher input 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.

Our Food Budget 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 feard 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 2000 A.D., i.e. in next 10 years, the need would be between 235 and 250 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

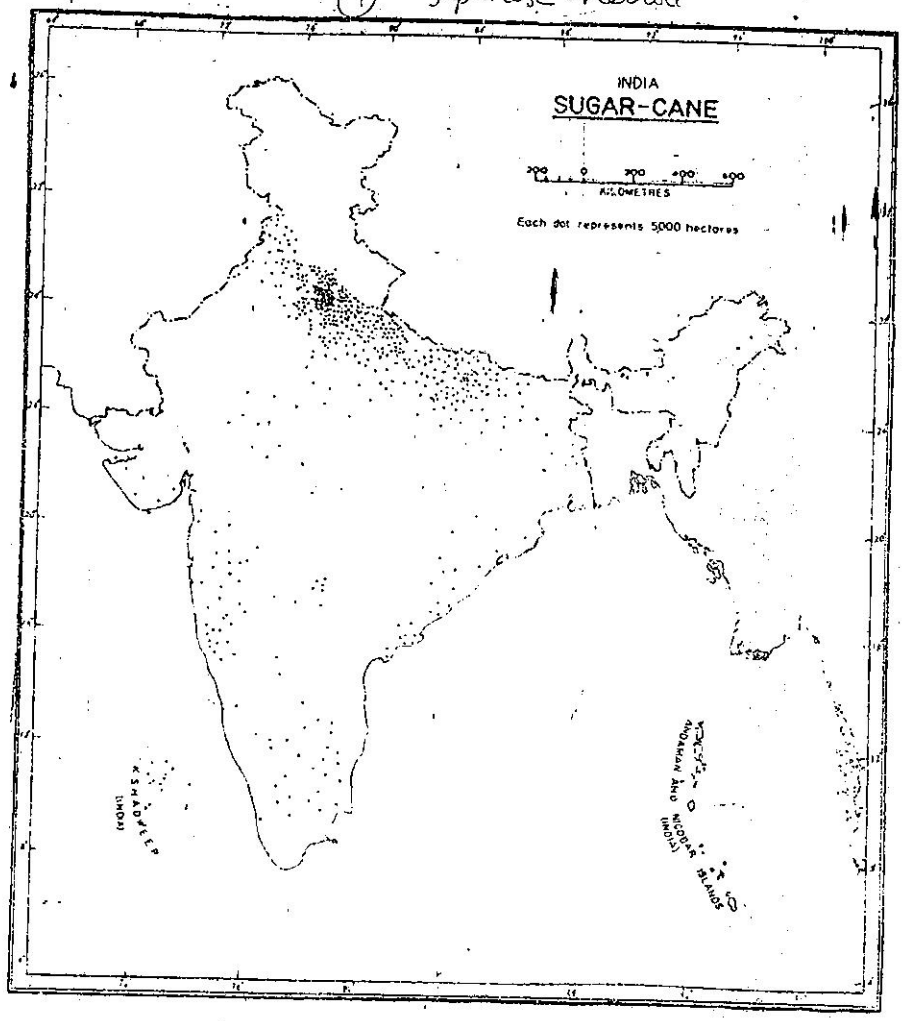
Vegetable oil being the common medium of cooking, oilseeds are as important as the pulses. The principal oilseeds are groundnuts, rapeseeds and mustard seeds. While the former is a kharif crop, depending entirely upon moderate but timely rainfall, the latter is a rabi crop essentially confined only to 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, 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 1950-51 the groundnut production was 3.5 million tonnes. It rose to 6 million tonnes in 1970-71. And in 1985-86 it was 5.5 million tonnes only, whereas it had touched 7 million mark in 1983-84. The production of rapeseed and mustard seeds, however, is more steady. It has risen from 0.7 million tonnes in 1950-51 to 3 million tonnes in 1984-85, dropping next year to 2.6 million tonnes. The total oilseeds production over that the last thirty-five years has risen from 5.1 million to 12.9 million in 1984-85. It again declined to 11.1 million tonnes in 1985-86. Their productivity has crawled from 4.8 quintals to 5.9 quintals per hectare in 1985-86. Recently, improved varieties of mustard and rapeseed has led to increased production in 1988.

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.

In 1950-51, the area under sugarcane was 1.7 million hectares. It rose to 2.9 million hectares in 1986-87. The production jumped from 57 million tonnes to 182 million tonnes during the same period. Thus



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

Fig 6.3 India—Distribution of Sugarcane

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

the productivity has nearly doubled from 33 tonnes to 60 tonnes per hectare. In Hawai it is more than three times the national average for India. In Tamil Nadu it is as high as 100 tonnes because it is a tropical crop.

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 1986-87, 825,000 hectares were under potato. The production was over 12 million tonnes. Since 1951 area under potato increased by 244 per cent, production by over six times and yield per hectare by 123 per cent. In countries like the USSR, 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 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 1985-86 India exported spices worth 255 crores of rupees. Pepper exports reached a high of 37,000 tonnes worth nearly 200 crores of rupees. Cardamom exports were worth Rs 53 crores. But the country has now to import cloves, nutmeg, mace, cinnamon and cassia worth Rs 25 crores.

Fruit

Intensive cultivation of vegetables, flowers and fruits is called the 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 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 1985-86 India's export of cashewnuts was of the order of Rs. 215 crores. Research has shown that the current production of 2 kg per tree could be raised almost ten-fold.

The potential of horticulture in India still remains almost untapped. In 1979-80, the area under banana was 274,000 hectares with production at 4.3 million tonnes. Nearly one million hectares of land was under mangoes and its production was 8.4 million tonnes. Apples were grown in an area of 138,000 hectares with an annual production of 718,000 tonnes in 1979-80. Between 1967 and 1987 there was ten-fold increase in apple production.

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.

Tea grows well in deep and fertile well-drained soil. 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

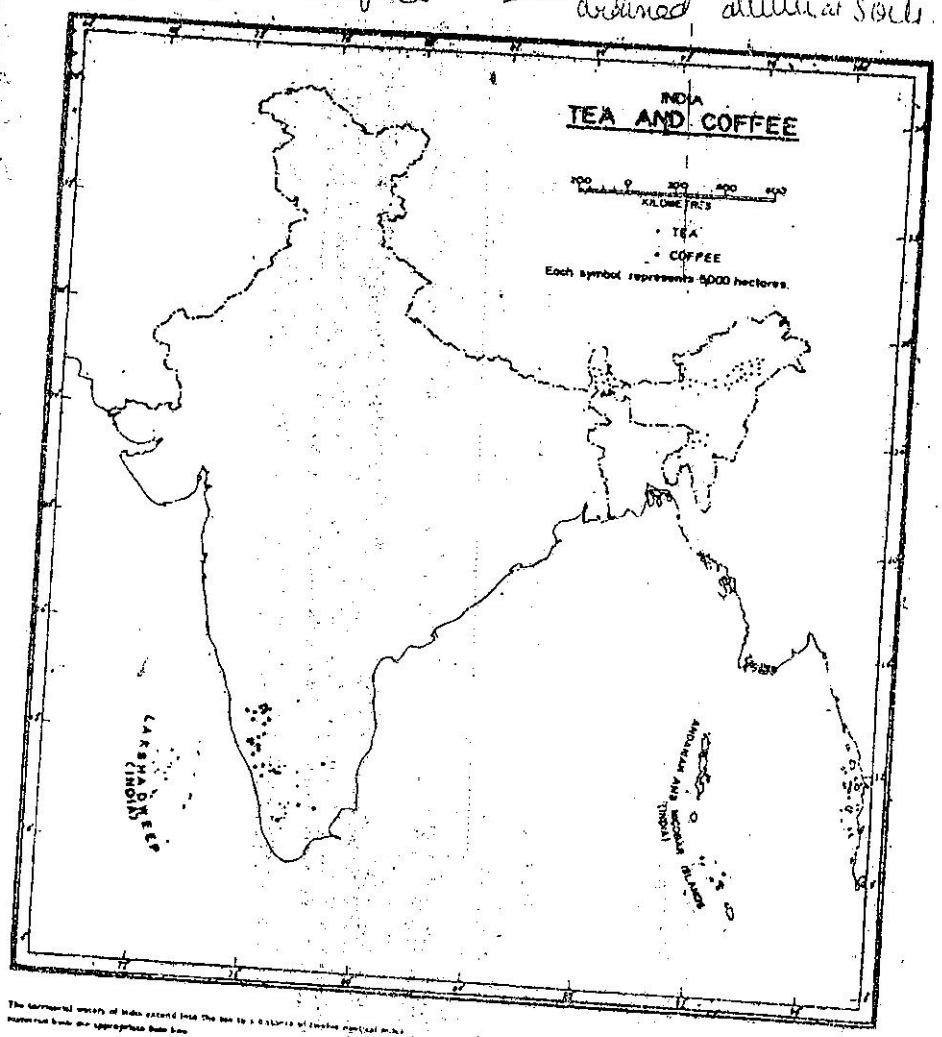


Fig 6.4 India—Distribution of Tea and Coffee
Note the areas producing tea and coffee. Name the states known for tea/coffee cultivations.

quality.

In 1950-51, there were 314,000 hectares under tea cultivation. The area rose to 375,000 hectares in two decades. The production, which was 275,000 tonnes in 1950-51, has steadily risen to 673,000 tonnes in 1987 accounting for half of the world output. The exports have also risen to 210,000 tonnes in the same year, fetching nearly 639 crore rupees. 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.

It stands next only to tea as a popular beverage 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, Tamil Nadu and Kerala. In 1950-51 the area under coffee was 91,000 hectares with a production of 25,000 tonnes. In 1984-85, the area under coffee had risen to 234,000 hectares and production was 160,000 tonnes. In 1985-86, nearly 100,000 tonnes of coffee were exported earning 275 crores of rupees. The yield per hectare has risen from 2.7 quintals to nearly 7.5 quintals.

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 civilization 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 considirably 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 the area under cotton was 5.9 million hectares. In 1985-86 it rose to 7.5 million hectares. The production also increased from 3 million bales of 170 kg each to 10.4 million bales in 1988-89. Yields per hectare also more than doubled from 88 kg. to 193 kg in 1985-86. India has been the first country to evolve recently a hybrid cotton variety. As a result, 1988-89 production was much higher.

Jute

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 that produce jute and its another variety *mesta*.

In 1950-51 area under jute was 0.57

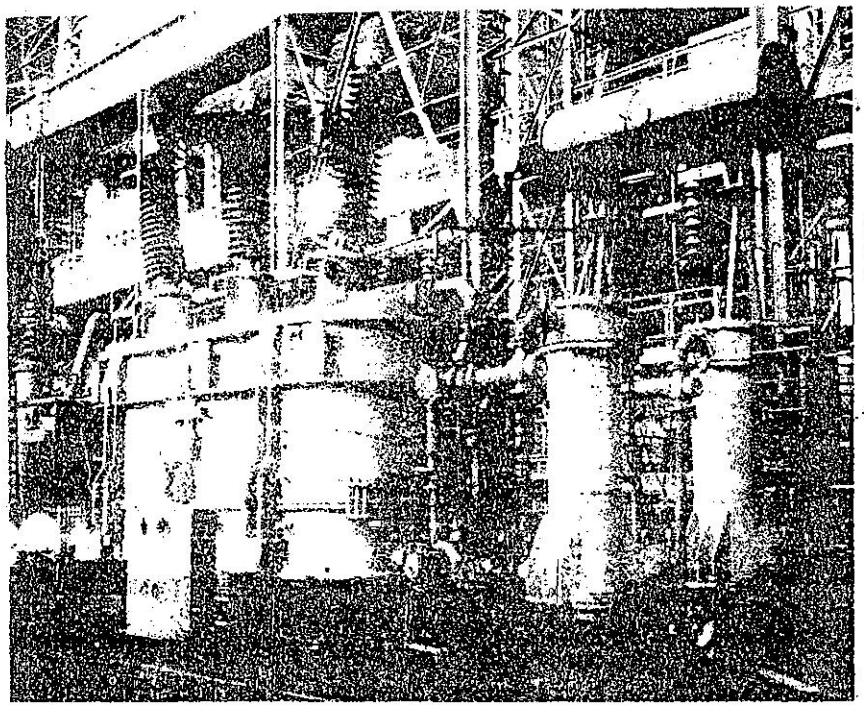


Photo VIII Heavy Electrical Industry

This is India's first and largest 2,60,000 KVA Transformer completely designed and manufactured by Bharat Heavy Electricals Factory at Bhopal. It weighs 240 tonnes.

ships. Generally they accommodate ships up to 10,000 DWT. But one dock at Bombay can admit a ship up to 20,000 DWT. The other at Visakhapatnam can allow a ship up to 70,000 DWT and at Cochin up to 1 lakh DWT. Cochin shipyard has built 3 bulk carriers of 75000 DWT each. It now manufactures battleships for the Indian Navy. There are plans to manufacture aircraft-carriers in India. Such a ship will take a few years to complete, after the work is commenced.

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 plane 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 1360 crores of rupees. By 1988 it rose to 6500 crores. This represents nearly a five times growth. In a single year 1987-88 the growth was 37.7%. The industry has a 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.

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.

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 1985-86 drugs worth nearly 194 crores of rupees were exported.

Petro-chemicals

Owing to their superior properties, petrochemicals 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 Bombay and Vadodara. Now it is spreading to other parts of the country.

Fertilizer Industry

According to one estimate, the natural fertility of our soil is capable of producing only 81 million tonnes of foodgrains. In 1988-89 we crossed 170 million tonne mark. By 2000 AD our foodgrain requirements would rise to about 235 million tonnes and by 2050 AD when the population is likely to stabilise around 1500 million, the food requirement would rise to 380 to 400 million tonnes. This would explain the need to augment fertilizer production on a continuing basis for decades to come.

When we became free the use of fertilizers was almost nonexistent. By 1950-51 a modest beginning was made in producing fertilizers at home.

In 1950-51 the world's average consumption of fertilizer per hectare was four times that of India.

In spite of spectacular rise in production, the country has to import fertilizers from abroad to augment the local supply. By 2000 AD the country's needs are estimated to be around 20 million tonnes and by 2050 AD. 40 million tonnes of fertilizers. In 1987 the country had 42 large fertilizer plants and 70 small plants in different parts of the country. So far they tended to be located near the reserves of raw materials like coal and petroleum and big power plants that had enough electricity to produce nitrogeneous fertilizers from the ni-

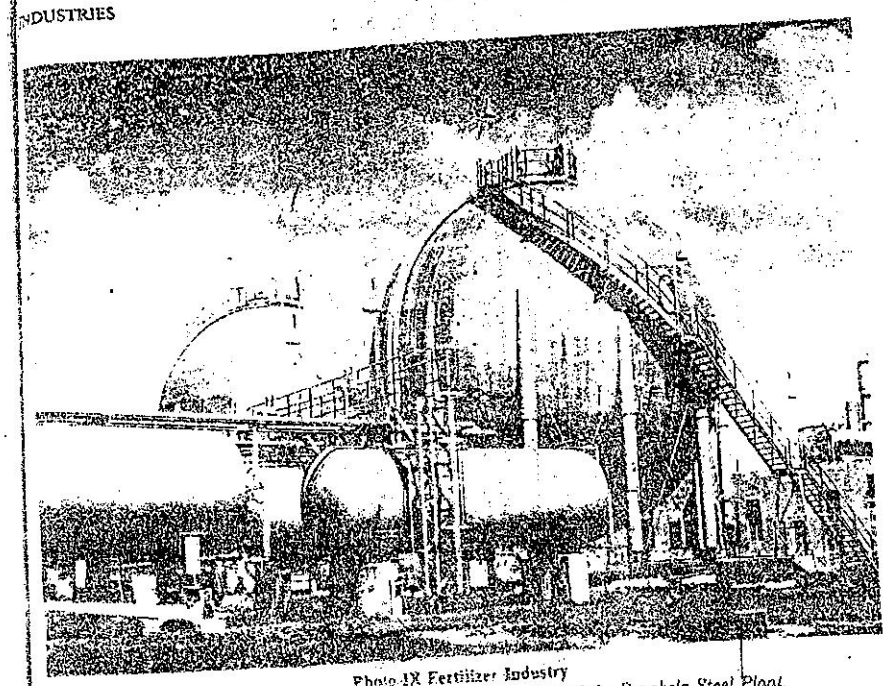


Photo IX Fertilizer Industry
This is a view of Ammonia tanks in the fertilizer plant of the Rourkela Steel Plant.

TABLE 7.3

Production of Fertilizers

	1950-51 (tonnes)	1986-87 (tonnes)	1988-89 (tonnes)
Nitrogenous fertilizers	9000	54,10,000	65,55,000
Phosphetic fertilizers	2000	16,60,000	22,69,000
Consumption of fertilizers per hectare (includes imported one)	2 kg	50 kg	62 kg
		(1,100,000) tonnes import	(15,00,000) tonnes import

trogen in the air. Now a new element namely natural gas has appeared on the horizon. It provides valuable raw material. But more importantly, through pipelines it can be easily transported to the desired market distribution centres. The result would be equitable distribution of industry and great reduction in the load on railways and also in transportation costs. 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.

Though fertilizer plants have raised their operational capacity to 80-84 per cent, yet 1.5 million tonnes of fertilizers had to be imported in 1988-89.

The Cement Industry

The cement consumption is an index of growing tempo of industry and construction work. 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 Madras in the south in 1904. There are nearly 150 factories today widely scattered all over the country. In 1950 the cement production was just 2.7 million tonnes. By 1987 the installed capacity was 54 million tonnes, and the production of cement had risen to 44 million tonnes in 1988-89. It was nearly two and a half times the 1980-81 production. The industry is both in private and public sectors. Limestone is the major raw material. The production target of 50 million tonnes has to be realised by 1989-90

Defence Production

Constant vigilance is the price of freedom. Our priority, therefore, is an indigeneous 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 in regard to their labour intensive and capital intensive nature, and their other contribution to Indian economy.

(i) Bangalore	—	Electrical rail engines
(ii) Calcutta	—	Electrical turbines
(iii) Chittaranjan	—	Railway coaches
(iv) Cochin	—	Big oil refinery
(v) Gurgaon	—	Aircraft
(vi) Hardwar	—	Stainless steel
(vii) Kapurthala	—	Fertilizer
(viii) Mathura	—	Gem cutting
(ix) Salem	—	Steel alloy
(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 national wealth
   (iii) Can industrialization eradicate poverty

UNIT FOUR

Trade, Transport and Communications

As a result of territorial division of labour and large scale production in agricultural and industrial sectors the ways of our living have undergone tremendous change. Efficient means of transport and communications is a pre-requisite of the modern industrial societies. Roadways, railways, waterways and airways together with various means of communications have become the lifelines of the nations and their economies. They help in quick movement of raw materials and finished products. Thus they help in both production and distribution. They help in increasing the mobility of people to add to their earnings and emotional satisfaction.

Fast means of transport, backed by far more powerful and instant means of communications, have made our world a small and compact place to live in. Many individual families are spread over different continents and their members can talk to each other instantly and meet at a common place only at a few hours notice. Market developments of one country affect markets of several other countries. We are now living in an increasingly interdependent world.

India of today is a well knit family despite its size, diversities and linguistic and other variations. Railways, airways, newspapers, radio and television, and cinema have been contributing to its emotional integration and socio-economic regeneration.

The trade both at national and international levels has added to the vitality of the economy. It has enriched our life and added substantially to growing amenities and comforts of life. It underlines basic universality of human cultures.

Trade, Transport and Communications

We are now living in a progressively shrinking world. All the three domains of the earth—land, water and air, provide excellent media of transport. The land transport network consists of roads and railways. The waterways comprise deep-sea, coastal and inland navigation. Atmosphere offers scope not only for air travel through aeroplanes but also a means for wireless communication, the fastest of its kind.

FOR DOING IT YOURSELF

1. Go through the list of means of transport mentioned below and classify them according to the three domains—land, water and air—of the earth.

Means of Transport

(i) Aeroplane, (ii) Animal cart, (iii) Beasts of burden, (iv) Boat, (v) Bus, (vi) Canoe, (vii) Car, (viii) Dugout, (ix) Helicopter, (x) Jet plane, (xi) Liner, (xii) Raft, (xiii) Railway train, (xiv) Sail-ship, (xv) Sail-ship with the mast, (xvi) Sledge, (xvii) Space-ship, (xviii) Space shuttle, (xix) Steam ship, (xx) Tanker, (xxi) Tram, (xxii) Truck.

In each of the three categories, re-arrange items (a) as per their chronological order; and (b) their speed from slowest to the fastest.

2. One fine morning the sea-route distance between Bombay and London was reduced by as much as 7000 km. Find out what it was due to.

Likewise there was a time when it took a few months to send a message from India to London in the UK. Now the travel time is reduced to a few hours only and communication is instant. Find out similar facts and write a short note on our shrinking world.

3. Study the table carefully. Draw your inference of how best each one of them can best meet its all the requirements.

TABLE 8.1

S No.	*Country*	*Produces more than its needs*	*Produces just enough to meet its needs*	*Indiffe...nt in meeting its needs*
1.	Myanmar	Rice and teak	cotton	Machine and tools
2.	India	Cotton textiles, tea, jute, iron-ore, leather goods	foodgrains	Mineral oil, petro-chemicals and weaponry

3.	USSR	Mineral oil and petro-chemicals, weaponry	Foodgrains, timber, paper	Cotton wares, leather goods, consumer goods
4.	Japan	Automobiles, electronic goods, ships	Timber, paper, fish	Mineral ores, coal, petroleum, food, wool, cotton

4. Study Table 8.2 carefully.

TABLE 8.2

Roads and Road Traffic

Roads	*1950-51 km*	*1982-83 km*
(a) Surfaced	157,019	731,132
Unsurfaced	242,923	823,072
Total length	399,942	1,554,204
(b) Road Density per sq km.	0.12	0.44
(c) Comparative Road Density	India 1	Japan 14
Road/Population Ratio (1961)	India 1	USA 33

(i) Find out which of the roads — surfaced or unsurfaced — have been increasing rapidly.

(ii) See how India compares with Japan and the USA in regard to road density and roads and people ratio.

5. Study Table 8.3 and do the activities given below.

TABLE 8.3

Principal Commodities Comprising Railway Freight:
(A Changing Scenario Over Three Decades)

		1950 (in %)	*1979-80 (in %)*
1.	Coal	30.91	75.78
2.	Cement	2.47	10.04
3.	Iron Steel	2.75	10.47
4.	Foodgrains	7.80	18.35
5.	Oilseeds	1.59	0.45
6.	Sugarcane	2.82	1.09
7.	Sugar	0.93	1.17
8.	Chemical Fertilizers	0.59	8.23
9.	Mineral Oil	2.69	14.27

(i) List two commodities having a declining share in freight. See if you can explain it in each case.

(ii) Identify the most dominant commodity in railway freight. Find out how its share can be reduced.

(iii) List items to show how railways have been increasingly contributing to growth of agriculture.

(iv) Write down implications of growing rail traffic in cement, iron and steel, and mineral oil.

(v) Find out how the growing burden of mineral oil on railways can be reduced to the minimum.

(vi) Guess about the railway freight scenario of 1995 pointing out major expected changes.

6. Study Table 8.4 and do the activities given below.

TABLE 8.4

Indian Railways

		1951	*1996*
(A)	Total Route Length (km)	53,596	61,836
	Electrified Route Length (km)	388	6,517
(B)	Running Track (km)	59,315	77,135
(C)	Number of Locomotives	8,209	9,920
	(a) Steam	8,120	5,571
	(b) Diesel	17	3,047
	(c) Electric	72	1,302
(D)	Number of Wagons	205,596	359,614
(E)	Number of Coaches	19,628	38,184
(F)	Goods originating (in million tonnes)	93	286

(i) Note that route length has not increased much, but running track has increased considerably. See what inference you can draw.

(ii) Compare the growth of locomotives with wagons and coaches. Draw your own inference. Also take note of the tremendous growth.

Early man, as a hunter and food gatherer of necessity, had to lead a nomadic life. Agricultural revolution, some five thousand years ago, opened up new possibilities of leading a settled life. It was a step towards modern civilization. The self-contained village economy, so characteristic of India, was a natural conclusion of his quest for such a life. It was indeed a high point of his 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 toward ; interdependent, if not integrated, global economy. In this chapter you would see how the modern means of transport and communication serve as lifelines of our nation and its modern economy.

TRANSPORT

Roadways

Roads have preceded railways. They still have an edge over railways in view of the

ease with which they can be built. They can negotiate higher gradients of slopes and as such can traverse mountains. They can be made to pass through forests and deserts. They can be brought to our door steps. The roads are of two types according to their strength and make up: surfaced and unsurfaced. The best roads are the surfaced roads, also called the *metalled roads*. Surfaced roads may be made of cement, concrete or even bitumen or tarcoal. The surfaced roads are all-weather roads unlike the unsurfaced or kucha roads, which are of little use during rains.

Since Independence the surfaced roads have increased by more than four times. Unsurfaced roads too have increased by over three times. The importance of unsurfaced roads, confined mainly to rural areas, cannot be over emphasised. These roads open up the countryside to the modern ways of living based primarily on money culture. The fact that even today India has 15 million bullock carts carrying nearly 900 million tonnes of goods, of course, over short distances, cannot be brushed aside. Bulk of this traffic is carried over unsurfaced roads.

The road density in India has increased from 12 km to 44 km per square kilometre of area. But this is nothing when compared to other advanced countries like Japan and USA. The road density of Japan is 14 times that of India. In the USA the ratio between roads and population is 33 times more favourable than that of India.

The case of Kerala is interesting enough to establish the socio-cultural significance of roads. For instance, Madhya Pradesh, the largest state in India, has only 1,13,176 km of roads, but Kerala, only one-eleventh the size of Madhya Pradesh, has 1,04,850 km of roads. As such this has been a contributing factor in the high rate of literacy in rural areas, low infant mortality rate and very high percentage of people taking to family planning even in the countryside where bulk of its population lives.

The roads are also classified in yet another way: (i) national highways, (ii) state highways, and (iii) district and village roads. Whereas the Union Government is responsible for the construction and maintenance of the national highways, the state governments take care of the rest.

The total length of the national highways was 32,138 km on 31 March, 1987. This represents an increase of 50 per cent in a period of 35 years. Although they constitute only 2 per cent of the total length of the roads in India, they carry nearly a third of the total road traffic. Look at the map of national highways in your atlas. Locate and trace the first ten national highways and note the end-points they connect.

The importance of national highways is clear from the passenger and goods traffic they carry. Therefore, the role which the Union Government plays in their development is understandable. However, the Union Government is entrusted with yet another kind of roads namely the *border roads*. Think of the total length of our international frontiers along the states of Gujarat, Rajasthan, Punjab, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim, West Bengal, Arunachal Pradesh, Nagaland, Manipur, Mizoram and Tripura. Add to it the highly inhospitable terrain, relief and climatic conditions in which our jawans have to guard and protect these frontiers day in and day out throughout the year. It is only through the border roads that their supply line can be maintained, irrespective of physical otids and extremely harsh climatic conditions.

It is in this context that the example of a Manali-Leh road, the highest in the world, can be quoted. This road in the Ladakh region runs at the average height of 4,270 metres above mean sea level. It negotiates four high passes of the world ranging between 4,875 and 5,485 metres above sea level.

Besides extending the length of the roads, there is a constant need to see that they are not only well maintained but also fit to cope with the growing traffic both in terms of their load and increased speed eliminating the chances of accidents. Therefore, when necessary they are widened, strengthened and converted from a single lane track into double or even multiple lane track.

The road passenger traffic is mainly handled by state transport corporations. Forty per cent of the buses are in public sector. In the year 1985 they had a fleet of over 86,000 which has increased by over 50,000 during past 15 years. They carry 48.4 million passengers a day and employ 6,25,000 persons. The goods traffic by road is entirely in the hand of the private sector. The number of registered trucks increased from 81,488 in 1950-51 to 7,63,000 in 1984-85. The goods traffic increased from 5.5 million tonne km in 1950-51 to 81 million tonne km in 1978-79.

Railways

Railways were introduced in India in 1854 primarily to serve the interests of the then imperial power. They were expected to play an important role in improving the strategic strength of imperial armed forces by increasing their mobility. In fact railways were used in draining away Indian raw materials for the growth of the British industries. In turn they were also used in developing a market for their manufactured goods. Furthermore, it was an attractive investment for the British capital. This explains their rapid development at a huge cost. However they proved beneficial to our country in many ways. They have become more important in our national economy than all other means of transport put together.

At the time of Independence the Indian railways were in a bad shape. They were suffering from the excessive strains of World War II. They were denied their due in terms of maintenance, upkeep and normal replacements arising out of wear and tear. Railway workshops instead of catering to the needs of the railways were made to engage in production of war materials. Some railway lines were dismantled and sent to the war theatre. Over and above this, a part of the railway network went to Pakistan at the time of partition giving rise to numerous human, financial and administrative problems. Railways suffered huge losses in riots and had also to handle unprecedented human migrations across the border in both directions.

It is clear that there has not been much of an increase in the total length of the railways but there is a significant increase in actual running track, indicating laying of additional lines on the already existing busy routes. There is a distinct effort to electrify major railway routes. Now about a tenth of the railway track is electrified. It serves two purposes simultaneously. Firstly, it relieves railways from carrying coal to distant parts for its own steam engines. Secondly, it ensures more speedy movement of traffic by doubling their capacity. It also means a cleaner travel for the passenger and freedom from air pollution for the people. Similarly, the spectacular rise in the number of diesel engines highlights railways primary concern to increase its traction power. Compare the increase in the total number of railway engines, coaches and wagons during this period. What does it indicate? It is noteworthy that 96 per cent of the total goods traffic in terms of gross tonne kilometres in 1984-85 was hauled by diesel and electric locomotives. As a part of

modernisation programme, multi-channel micro-wave link for fast and reliable communication was in operation for 14,182 km, and automatic signalling was introduced over a track of 1693 km.

Indian railways still consist of three types of gauges, (a) broad gauge (1,69 metres), (b) metre gauge (1 metre), and (c) narrow gauge (0.77 metres). The third category is confined to only a few hill stations where only a light railway is found viable. However, for the continuation of metre gauge there is not much of a justification except perhaps the paucity of funds to replace them by the broad gauge. Transhipment of goods from one gauge to the other leads to delays and losses, which are avoidable. Not much progress has been registered in this direction in spite of railways' pronounced policy of having only a single broad gauge railway track all over the country.

Over 96 per cent of the passengers travel by the second class. Due to overcrowding, their plight is beyond description, particularly those who have to travel long distance. Provision of more and more sleeper coaches is a step to meet the challenge. Computerised reservation system is yet another measure to the same end. It has reduced malpractices considerably.

Railways real earnings are from goods traffic they carry. In 1984-85 their goods traffic revenue was Rs 3465 crore as against Rs 1292 crore from second class passengers.

Railways have to cope with the changing pattern of the agro-industrial scenario of the country. Its contribution to agriculture can be adjudged from the increased amounts of fertilizers and foodgrains it has to carry year after year. Likewise, coal mineral ores and mineral oil have now become the dominant commodities to be hauled over long distances. Electrification of railway track, setting up of thermal power stations near coal and lignite mines, increased use of hydro-electricity and greater use of natural gas to produce electricity are some measures that would ease the burden on the railways. The pipelines carrying mineral oil and natural gas, separately, are also the steps in the right direction.

Railways have introduced long distance super fast trains running well over hundred kilometres per hour. Three trains cover over 3000 km each. Guwahati-Trivandrum Express covers the longest distance of 3974 km. There are eight express trains covering between 2000 and 3000 km each. Find out these trains, the terminals they connect, time they take, the states they traverse and important cities they touch on their way. Where would you get all this information? List trains that especially connect Delhi to various state capitals. Railways have also introduced fast goods trains to carry priority goods quickly to their destinations. *Container service* has been introduced to provide door to door service which the trucks had been doing so far. The container services reduce transport and delivery time. They ensure greater security of goods and freedom from pilferage. The services have proved more economical to both the railways and its customers.

An account of Indian railways would remain incomplete without a passing reference to its role in promoting fast and inexpensive traffic in metropolises like Bombay, Madras and Calcutta—particularly its Metro Service.

Indian Railways is one of the largest government organizations. As many as 16,03,000 persons are on its regular pay roll and another 200,000 work as casual labour. Railways have to take care of their welfare and working conditions including job satisfaction.

Pipeline Transportation

Pipeline transport network is a new addition 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 the proposed one at Karnal, and gas based fertilizer plants currently under construction 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 for Salaya in Gujarat to Mathura via Viramgam covering a distance of 1220 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. A Bombay-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 1730 km in length would supply gas to six fertilizer plants and two thermal power plants based on natural gas. Its initial capacity is to carry 182 lakh std cubic metres per day. Owing to these facilities Delhi has decided to gradually switch over to natural gas for producing electricity.

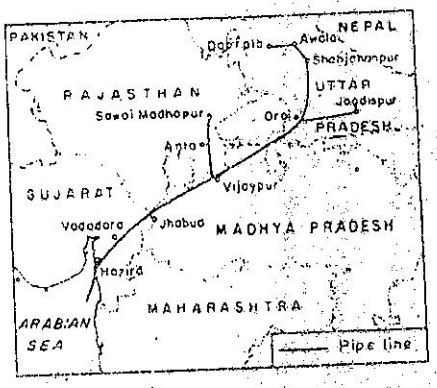


Fig 8.1 HBJ Pipeline

Note the route of the Hazira-Bijaipur-Jagdishpur (HBJ) Pipeline which has been constructed to transport natural gas covering a distance of 1700 kilometres. Find out the names of the six proposed fertilizer factories based on this gas.

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 and deep-sea fisheries. India's territorial waters

TABLE 8.5

Foreign Trade
(Value in crores of rupees)

Year	Imports	Exports	Total Value	Balance
1950-51	581.17	606.81	1,187.98	+25.64
1960-61	1,121.62	642.39	64.01	-479.23
1970-71	1,634.20	1,535.16	3,169.36	-99.04
1980-81	12,549.15	6,710.71	19,259.86	-5838.44
1986-87	20,083.53	12,566.62	32,650.15	-7516.91

measurement for sea distance

extend up to twelve nautical miles. It has some of its rich oil fields in the deep sea away from the coastline. Its 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.

The importance of oceanic waterways for the country can be judged from the foreign trade we conduct every year. Both our imports and exports are important for our economic growth and development. Table 8.5 presents a picture of our foreign trade since Independence in terms of its value.

Although bulk of the international trade is carried by seaways, a part of this trade is also carried on land and by air across the borders.

During a period of 36 years, the value of trade has increased by over 27 times. During the same period the imports have increased by about 34 times, but exports have lagged behind as they could barely increase by 20 times. As a result, the gap between exports and imports has been generally widening, from a meagre amount of about 100 crore rupees in 1970-71 to as much as 7516 crores of rupees in 1986-87. A more realistic statement could be that the gap is as large as one and a half times of our exports in the year 1986-87. This is a situation which should cause grave concern to all of us.

Among our exports, the first six items at the top in 1950-51 were (i) cotton yarn, thread and textiles, (ii) jute manufactures, (iii) tea, (iv) vegetable oils and materials, (v) leather hides and skins; and (vi) tobacco.

However, during three years 1983-84, 1984-85 and 1985-86, entirely different items have displaced them. The items in order are: (i) gems and jewellery, (ii) cotton fabrics, garments and articles, (iii) tea, (iv) machinery and transport equipment, (v) iron-ore and (vi) leather, leather goods and footwear. The nature of exports in the eighties indicates a new trend. The items of export, unlike the one in early fifties, are not raw materials or semi-processed goods. They are articles in which value has been added through skills e.g. gems and jewellery, cotton garments, leather goods or footwear. Others are of mineral origin and belong to the class of engineering goods. It throws light on the fast changing nature of our national economy, which was predominantly primary in nature. It clearly shows that with agriculture as the base of our economy, we are gradually moving towards the secondary sector of economy. There is tremendous scope to add value to our primary products, and at the same time utilise our huge man-power resources. The export of a large number of engineering goods and high value sophisticated items like electronics is a prerequisite to turn the balance of trade in our favour. Do you notice a large number of items in which our production has increased considerably but which do not figure in our export lists? This is because of our own evergrowing home market. Do you justify the rapid growth in our iron-ore exports? Is it not interesting that we import large amounts of precious stones and cashew nuts and export them again? What are we really exporting? Apparently those items but something else of greater significance which we have in abundant measure, namely human skills.

Let us move from exports and imports to the gateways through which they have to pass, namely our ports that give access to oceans, providing links with other continents or far-off lands.

Major Ports

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

Kandla in Kuchchh was the first port developed soon after Independence to ease the increased pressure on Bombay port in the wake of loss of Karachi to Pakistan. In order to cater to the north western 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. Bombay 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 in 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. Cochin 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 courty. It handles a variety of cargo including coal, salt, edible oils, chemicals etc. Madras is one of the oldest but artificial port on the east coast. It handles general cargo and ranks next only to Bombay. The trade of this port comprises petroleum products, crude oil, fertilizers, iron ore and dry cargo. Visakhapatnam in Andhra Pradesh is the deepest land-locked 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 eighty miles 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 major port has been developed down stream at Haldia. It supplements the facilities available at Calcutta. Haldia handles mineral oil, petroleum products, fertilizers and other dry cargo.

Shipping Fleet

In 1947 the total weight of India's ocean-going ships was not even two lakh tonnes. However by 30 June 1987, the total tonnage was 6.32 million tonnes. It has thus increased by more than 30 times. India now owns the largest merchant shipping fleet among the developing countries and stands 16th in the world's shipping tonnage.

India has 226 minor ports along its coastline of over 6000 km. They promote coastal trade along with fishing. There are tremendous possibilities of increasing our fish-catch in coastal waters and deep seas. Already fish and fish preparations have appeared on our export list, with bright prospects in near future.

India's major rivers like the Ganga, Brahmaputra, Godavari, Krishna, Mahanadi, Narmada and Tapi together provide inland navigational potential for about 5200 km. They are navigable by mechanized craft. But only 1700 km are presently being utilized. In addition there are some navigable canals, very little of which are being actually utilized. Besides Brahmaputra, it is expected that now Ganga too would be used for navigation between Farrakka and Patna to begin with, and then up to Allahabad in due course. Water transport is cheaper than road transport as the element of friction during traction and maintenance are less. This compensates for its slow speed.

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 Bombay 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.

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 or inland waterway, 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 may also be more economical.

In 1947, Indian civil aircraft airlifted 310,000 passengers. Their annual total number crossed one crore mark in 1985. In 1953, the Indian government set up two public sector undertakings. Since then the Indian Airlines take care of domestic travel and Air India looks after international travel. In 1981, the third airline called Vayudoot was incorporated. It runs feeder services to supplement the Indian Airlines.

The Indian Airlines have succeeded in putting almost all the state capitals on the air map of India. This is true also of industrial centres and places of tourist interest. Besides the four metropolitan cities, namely Bombay, Calcutta, Delhi and Madras which have international airports, there are 91 civil aerodromes maintained by the Ministry of Civil Aviation, as on 1 June, 1986 and 110 aeronautical communication stations. The Indian Airlines runs air services to the neighbouring countries of

Afghanistan (Kabul), Pakistan (Lahore and Karachi), Nepal (Kathmandu), Bangladesh (Dhaka), Sri Lanka (Colombo) and Maldives (Male). The Indian Airlines had a total fleet of about 50 aircrafts in 1987. It consisted mainly of Boeing 737 and Airbuses. The latest addition has been the Air Bus 320.

Air India has a fleet of about 20 aircrafts consisting of Boeing 747, Air Bus A 310, Air Bus A 300. India has airservice agreements with nearly 60 countries of the world.

Vayudoot in 1986 connected 52 stations through 177 weekly services. Its fleet is modest consisting mainly of small craft. It has, however, bright future in view of the growing tempo of industrialization and urbanization.

Promotion of Tourism

One of the dimensions of the shrinking world is the growing interest among people to understand cultures other than their own. This urge is manifested through an increasing number of tourists going round the world every year. They keep on clicking their cameras to capture men and their moods, monuments, places of scenic beauty and wild life in its natural glory. In the process they leave behind valuable foreign exchange in lieu of services they receive and purchases they make. Indian hotel industry and Indian handicrafts have thus received boost. In 1985 nearly 12,00,000 foreign tourists visited India and through them, it is estimated, that the country earned valuable foreign exchange worth 1300 crore rupees. For promoting foreign tourism, modern hotels with high sanitation standards and other amenities are a must.

India's tremendous potential to attract tourists from all over the world is almost beyond description. Only a mention of the regional contrasts, cultural diversities and the wide range of flora and fauna should suffice. Architectural extravagance of our historical monuments, very distinctive classical dances and music of various schools is yet another dimension. Hill resorts, fine beaches, places of winter sports, highly aesthetic tribal artifacts and fine workmanship of our handicrafts only need to be seen to be believed. The great success of "the festivals of India" in countries like the United States of America, the United Kingdom, France, the Soviet Union and Japan reveals the rich cultural heritage which this country can offer to the world.

COMMUNICATIONS

India is a country of villages. As against 3,949 towns, there were 557,137 villages as per 1981 census. The problem of providing modern means of communication should be understood against this background. By 1984, 99 per cent of the villages were provided with the facility of daily mail delivery service. By 31 March 1986 there were 15,682 post offices in urban areas and 1,28,559 post offices in the rural areas. To put it in yet another way, there was a post office for every 22.16 sq km of an area; and that every post office on an average served a population of 5,200 persons. In addition to the regular post offices, another 70,000 villages were catered through mobile counter service facilities.

For facilitating quick delivery of mail, Postal Index Number (PIN code number in six digits) and Quick Mail Service (QMS) systems have been introduced. Do you know the PIN code of your area? Do you write PIN code on every letter you write and post? Mail is carried by surface and air transport. All the state capitals are now served by air postal services.

In 1947 there were only 3,324 telegraph offices. In 1986 their number rose to

37,424. In 1985 more than six crore telegraphic messages were booked. Likewise, considerable progress has been made in providing telephone facilities which promotes simultaneous or instant two-way communication. Whereas there were only 321 telephone exchanges and 82,000 connections in 1947-48, their number has grown to 11,480 and 31,65,000, respectively in 1986. Now a new facility of direct dialling system (STD) has also been introduced. One can now dial directly persons in selected cities of the world. However, our telephone services are falling short of the ever growing demand, as is clear from ever-swelling waiting lists. This is in spite of a telecommunication satellite of our own, which has multiplied the capacity several fold.

For improving and accelerating telephone services in metropolitan cities, Mahanagar Telephone Nigam Limited for Bombay and Delhi have been set up in 1986. Growing telex services are being provided in major towns. There are over 200 telex exchanges and over 30,000 subscribers connections. Videsh Sanchar Nigam Limited, formed in 1986 looks after our overseas communication services.

Mass Communication

Mass communication plays an increasingly important role in our individual and social life. Our radio and television sets work through the electronic media. At the time of Independence there were only six radio stations. They are now 71. We can listen to news discussions, commentary on sports, music and advertisements provided by Akashwani, and similar services offered by other countries of the world. But now television goes a step further and we can both listen and see. Black and white and colour television sets are now available and Doordarshan keeps on telecasting programmes from its studios. In 1987 there were over 200 television centres, of which only 11 were full fledged ones; 5 relay centres, 4 SITE continuity centres and 6 INSAT stations. Their number is expected to cross 500 mark very shortly. SITE and INSAT stations were functioning as part of experimental schemes.

Radio programmes have an access only to 80 per cent of country's total area and 90 per cent of the total population. Radio is a powerful medium for promoting social education, continuing education and life long education, besides providing information and entertainment. Television programmes can have access only to 70 per cent of the total population. This does not mean that all these people are in position to watch Doordarshan programmes. Television programmes are still confined to those who can afford television sets in view of their high cost. In the mean time efforts are on to provide community viewing sets to village panchayats in rural areas. Another major weakness is that most of the centres show programmes telecast from Delhi station only. It may take considerable time to develop programmes in each centre in its own language. Like radio, television too has a tremendous potential not only for entertainment but also for educating the large number of illiterate and semi-illiterate people systematically.

Print Media

While radio and television belong to electronic and long distance media, newspapers and other periodicals fall in the category of print media. Over sixteen hundred dailies are (including different languages) published in the country today.

While post, telegraph and telephone render very useful personal service, they also contribute in promoting commerce and industry. But mass media—both electronic and print, perform altogether different functions. They are extremely powerful in transmitting information, knowledge, ideas, emotions and skills by use of symbols — words, figures, graphs often backed by background music to heighten the desired emotional effect.

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?
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 Bombay 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 2000 A.D.

Topic for Class Discussion

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

UNIT FIVE

Nurturing Our Human Resources

Humans like any other animal was indeed a creature of environment. Being fragile and almost defenceless, humans soon learnt the advantages of living in groups--clans and families. Although humans started as a mere biological species, they, over a period of time, managed to be a social animal. They developed faith in cooperative living and the art of communication. Curious as they were, first they keenly observed the environment together with various physical phenomena. This helped them in deriving their food from vegetal and animal kingdoms through selection and experimentation, though their natural urge, perseverance and increasing use of intellect, they succeeded step by step, in unfolding the secrets of their environment which once overowed them. Armed with the use of fire and versatile tools they became a much different species. Instead of being simply a part and parcel of the eco-system they began to manipulate environment to serve their interests.

Humans have progressed a lot since then. They have reached a stage of genetic engineering with the help of which they are able to develop improved strains of plants and domestic animals. We have now heavy yielding and early maturing varieties of trees, shrubs, vegetable and flower plants. Poultry, fish, cattle and other domestic animals have now been turned into highly efficient machines as it were to give us far more eggs, proteins, milk, meat and wool, etc. People have thus acquired a much different role and capabilities to derive maximum from their environment and various other species of the eco-system of which they themselves are still inseparable parts. Humans cannot control climate but are able to anticipate and predict various weather phenomena and through preventive measures protect their interests to a certain extent.

A time is not far when humans themselves would be subjected to such changes with far reaching social implications. The first step in this direction has been the newly acquired human ability to plan their families, the number of progeny and the required spacing between them. They are now able to improve their athletic skills, physical stamina and above all, average longevity. A nation that would develop its human resources selectively in a systematic manner and quickly enough will always have an edge over others. The highly industrialised countries have a head start in this direction.

What are the milestones it has to cross in this regard? The milestones to be covered in this regard are universal literacy, health for all, appropriate vocational

skills, proficiency in technical education and professionalism, sound work ethic, unlocking of women power through equality of sexes, and ever increasing use of science, technology and energy to improve productivity of labour. Improved productivity need to be backed with distributive justice to ensure that the fruits of development reach the lowest strata of the society. This is the only way to accelerate the pace of our socio-economic development to be able to survive in this highly competitive world.

CHAPTER 9

Human Resources

There was a time when the strength of human beings depended on their numbers alone. In the traditional agrarian society, manual labour was required for most of the work. Therefore, more people meant more production and thereby more prosperity. But this perspective changed with industrial revolution and the consequent developments in science and technology. Use of various kinds of tools, machines and sophisticated technology has reduced the dependence on manual labour considerably. Mechanization brought in speed and efficiency. Hence production increased manifold. For using and operating the sophisticated tools and technology, certain skills and abilities were required. Therefore, quality of people was considered important and gradually more emphasis was laid on the quality rather than quantity of people.

The population of a country is regarded as a potential resource and includes both quantitative and qualitative aspects. By quality of people we mean their economic efficiency or productivity, the level of their scientific and technological development, their cultural values and their social and political organizations. The growth and development of a human being and his/her total personality is rather delicate. It calls for sustained and concerted efforts on several dimensions simultaneously. In the process, a family, society and social institutions like the school have to play an important role. Human resource of a country is to be nurtured carefully in the best possible manner because it would ultimately determine how best the natural resources of that country can be developed. In this context, education, health, skill development, and proper work ethic and character building inclusive of social sensitivity have acquired over-riding importance.

A few tables are given against the above-mentioned perspective. They would throw up many points for you to ponder over and arrive at your own conclusions.

Our Population Growth

You have already seen three phases of population growth over nine decades— negligible, moderate and rapid. During the first phase of 20 years, it grew at a pace of 0.26 per annum. In the next 30 years the population growth rate was a little over one per cent per annum. In the last decade of the third phase, the growth rate jumped to 2.14 per cent per annum. In fact in just 34 years after Independence another India was added while the territorial limits of the country remained unchanged. Population grows exponentially like compound interest. With one per cent growth it does not take 100 years to double itself. It does so in just 70 years, while with 2 per cent growth

FOR DOING IT YOURSELF

TABLE 9.1

Total Population, Average Density of Population and Urban Population in India from 1901 to 1991

Year	*Total population (in million)*	*Density of population (per sq. km.)*	*Percentage of urban population to total population*
1901	238	77	10.84
1911	252	82	10.29
1921	251	81	11.18
1931	279	90	11.99
1941	318	103	13.86
1951	361	117	17.29
1561	439	142	17.97
1971	548	177	19.91
1981	685	216	23.34
1991	844	267	25.72

(i) Name the two decades when population was rather stable with negligible growth. Work out the net addition in twenty years. Find out average annual addition in lakhs for this twenty-year period.

(ii) State the three decades showing rather moderate growth of population. Calculate the net addition in thirty years. Work out average annual addition for this thirty-year span.

(iii) Mention the four decades with very fast growing population. Calculate the total net addition for forty years. Find out how many millions were added on an average every year.

(iv) Identify two separate decades which had sudden spurts in urban population. Find out the possible reasons thereof.

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	1134.0	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.

TABLE 9.3

Some Demographic and Other Related Indicators of a Few Countries including India

S.No	Country	Literacy Rate	Infant Mortality Rate	Birth Rate	Death Rate	Natural Increase	Life Expectancy Male	Life Expectancy Female
1.	Bangladesh	N.A.	128	44.8	17.5	27.3	55.3	54.4
2.	India	52.2	80	29.5	9.8	19.7	55.6	56.4
3.	Sri Lanka	N.A.	32.9	24.8	6.5	18.3	67.8	71.7
4.	China	N.A.	39.0	19.0	6.7	12.3	67.7	68.9
5.	Japan	99.9	6.0	12.5	6.2	6.3	74.5	80.2

(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.

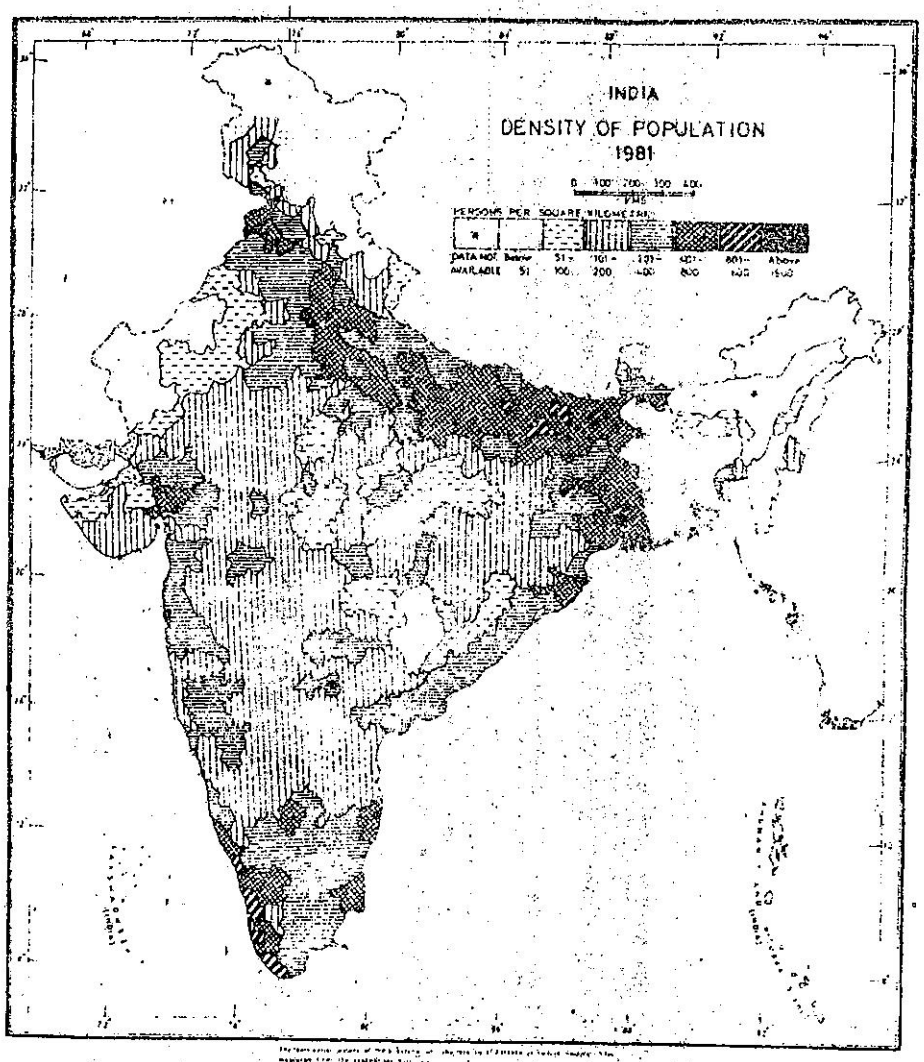
rate it takes merely 35 years. This is the rate at which we have been doubling ourselves.

We know that India has only 2.4 per cent of the world's land area over which we are now required to sustain our population which in the year 1991 was about 16 per cent of the world's total population. Our average density of population is over six times the world's average. You can imagine how crucial is this problem.

Distribution of Population

Look at the map of population distribution in India. The overall distribution of population generally corresponds with the soil fertility. The thickly peopled parts of India are the northern plains, the coastal deltas along the Bay of Bengal and coastal plains of the west coast including the plains of Gujarat. The density of population, by and large, is more in well watered parts of India and population goes on decreasing with growing aridity from east to west. West Bengal is the most densely peopled. The density decreases in the plains of the Punjab and Haryana. Kerala has a high density of population closely associated with ample rains enabling two to three crops a year and with abundant fish supply from its backwaters and deep seas.

The sparsely peopled parts of India are



9.1 India—Density of Population

Note the densely populated parts of India. Which areas on the map shown population density less than the national average?

the high mountain regions of the north, rainy forested lands of north-east frontiers and extremely arid lands of western Rajasthan extending up to Kachchh in Gujarat. The rocky and hilly regions of peninsular India including the Vindhyas and their eastern extensions are moderately populated parts of our country.

The Rural Urban Divide

India has the reputation of being a country essentially of villages, their number being over half a million. In the beginning of the century, nine out of ten persons lived in villages. The total urban population was nearly 26 million. By 1983 the total population of India increased more than 3 times. But the urban population rose by as much as eight times. Now one out of every four persons is an urbanite. To put it the other way round, for every city dweller there used to be nine villagers. Now there are only three villagers for every city dweller. In the first forty years the share of urban population improved just by three per cent. But in the next 50 years its share rose by 12 per cent–from 14 per cent to 26 per cent. The urban population of India in 1991 stood at 217 million. This number is more than that of the fifth most populous country of the world, the Island Empire of Indonesia, or even more than that of Brazil's total population.

In 1991, nearly 65 per cent of the total urban population lived in class I cities and towns with a population of one lakh and above. There were 300 such towns in 1991 as against 106 just 30 years ago. This trend of concentration of large urban population in big cities is highly alarming. Again if 300 cities account for 139 million of urban population 23 metropolitan cities cornered among themselves half of this population, viz. 70 million. Obviously this upsurge in population growth has put great strain on the existing resources and services available in cities and people are at times devoid of basic amenities. The situation in villages is also deteriorating. The landless peasants are gradually being marginalised. Even though the marginal farmers have a partial claim to their parental land holdings, these become uneconomic or non-viable, mainly due to their fragmentation. A steady increase in such non-viable land holdings results in making several small farmers surplus and they are pushed out to join the groups migrating to big cities.

The following table demonstrates how village people are being increasingly pushed to big cities. While in 1981, there were 12 metropolitan cities with a population of over 1 million, in 1991, their number increased to 23. Look at the fast pace at which they have been exploding rather than growing.

TABLE 9.4

Population in top ten (million plus) cities, 1991

Rank	*Metropolis*	*Population in 1991 (in million)*	*Growth rate, 1981-91 (in %)*
1.	Greater Bombay	12.6	33.43
2.	Calcutta	10.9	18.73
3.	Delhi	8.4	46.18
4.	Madras	5.4	24.99
5.	Hyderabad	4.3	67.04
6	Bangalore	4.1	39.87
7	Ahmedabad	3.3	28.94
8.	Pune	2.5	47.38
9.	Kanpur	2.1	28.81
10.	Nagpur	1.7	36.24

The Structure of Indian Population

Human populations are catalytic agents of change and development. They are the producers of goods and services, which are only means to an end, namely satisfying their needs and requirements and providing them with comforts and amenities of life. Thus human beings are both producers as well as consumers. The degree to which these needs are satisfied, determines the material level.

Occupational Structure

The occupational structure of our population is very lop-sided. Two-thirds of our population still lives on agriculture. In Japan this primary sector has only 10 per cent of its total working population. Those in the field of industry or manufacturing constitute only 10 per cent of the total working population. The rest i.e. one-fourth of our population is in the tertiary or service sector. This occupational composition makes it clear that a very small proportion of our population is directly engaged in "value addition" tasks that belong to secondary sector of economy. As a result, our total national income remains at a very low level. We shall have to change the current occupational structure by inducting more and more people into the manufacturing sector to bring in the needed prosperity to our country. As efficient producers they have to be productive citizens eager to improve their productivity. This is how they can satisfy their own needs and also contribute to the nation's wealth. In order to understand the nation's potential to take care of these goals, a mere discussion of total population, its density and distribution is not enough. One has to go into the structure and salient features of population—namely occupational distribution, sex ratio, age composition, growth rate and the health and education status.

The Status of Female Population : Sex Ratio

Human population consists of two components—female and male. The numerical proportion between the two is known as sex ratio. It is stated as the number of females per 1000 males. In our country for the past several decades males have been increasingly outnumbering females. While in 1901 there were 972 females for every 1000 males, in 1971 their number came down to as low as 930. This downward trend seem to have been arrested in 1981 as it rose to 933 but in 1991 it came down to 929. Indian society has certainly to go a long way to convert the unfavourable sex ratio into a favourable one which every civilized society of the world possesses. For instance in Japan it is 1038 females per 1000 males. However, there are intra-regional variations in the sex ratio within our country as well. Only Kerala has a favourable sex ratio equal to that of Japan i.e. 1040 females to 1000 males. Why should it be so ?

With unfavourable sex ratio, the female life expectancy too had been low as compared with the males. But the figures of 1981 census have shown that now females were a shade better. The average life expectancy at birth for females was 56.4 against 55.6 for males. Again in Kerala it was far better: 69.87 for females and 65.23 for males. Thus on an average a Kerala woman lived longer than her male counterpart by four and a half years. Certainly, with increased network of

Public health and medicare system, we have made tremendous progress. At the beginning of this century both males and females could expect to live on an average hardly for 23 years. In Japan a female has an average life expectancy of 80 years i.e. six years more than her male counterpart.

There are a number of factors that influence longevity of human beings. Literacy is one of the most significant factors. In 1991 the female literacy in our country was as low as 39.29 per cent as compared to 64.13 per cent for the males. And Kerala which leads the country both in literacy and life expectancy, had 86.19 per cent literacy among its female population. At the beginning of this century only 6 out of one thousand females were literate. After 90 years of efforts, there was sixty times improvement as in 1991 there were 392 literate women per thousand population. However even now 3 out of every five females in India are illiterate. When they cannot read and write their own names, how can we expect them to know the importance of sanitation, hygiene, nutrition, pre- and post-natal care on scientific lines? We should take note of the fact that all advanced countries have overcome sex differential in this crucial area by totally wiping out female illiteracy.

With regard to the economic participation, in 1981 only 14 per cent of the females were engaged in active labour force. Nearly half of them were agricultural labourers and one-third of them cultivators. Thus about 80 per cent of the females were in unorganized sector working for meagre wages and being denied any old age security. In contrast, about 48 per cent of the females above 15 years of age in Japan are active participants in the country's labour force. This has been mainly because of the availability of free and compulsory education to every Japanese between six and fifteen years of age. The actual attendance (and not mere symbolic enrolment) is 99.98 per cent.

While in developed countries like Japan, only 1 out of 20 married women between 15 and 45 years of age is a nursing mother, in India this ratio is as high as 1 to 7. In Japan 50 per thousand women are nursing mothers whereas in India it is 145.2 per thousand. Infant mortality rate i.e. death of children below one year of age per thousand live births is also high in India. The comparable figures of India and Japan are 80 and 6 respectively. The incidence of maternal mortality, i.e. death of women during child birth or soon after due to related complications, is very nigh in our country. Unfortunately all these problems are closely associated with our social perception and traditional outlook wherein, women were mainly confined to homes, and early marriages were encouraged.

It has been experienced by several countries that with education female participation in the labour force increases, and the age of marriage is also raised. This has an inverse relationship with the fertility rate, i.e. average number of children born to a woman during her reproductive period, maternal mortality rate and infant mortality rate.

In our country a girl's marriage below 18 years of age and that of a boy below 21 years of age is prohibited under law. This however needs to be enforced strictly.

Age Composition

After having seen various implications of sex ratio, let us move to another aspect of population—its age composition and the economics of it.

Population is generally divided into three groups (i) below 15 years of age, (ii) between 15 and 60 years of age, and (iii) above 60 years. The first group is that of children supposed to be entirely dependent on their parents. The second group consists of adults or workers who are supposed to be economically independent. The third

group comprises old people returning back to the category of non-workers.

The division of population into these groups is known as population pyramids. A comparison of population pyramids of different societies is found very useful.

In India as per 1981 census this three-fold division was as follows:

Age	*Per cent*
0 - 14	39.5
15 - 59	54.3
60 and above	6.2

Taking the first and third group together i.e. 45.75 per cent of our population is bracketed as dependent population. The remaining i.e. economically active population of 54.3 per cent has to suppport this dependent population. The proportion between the two is termed as *dependency ratio*. In India it is 83. That means every 100 persons in the age group of 15 to 59 have to support 83 persons who are dependent on them. Again, it must be noted that children below 15 years of age are bound to be highly demanding in terms of their nutritional, health and educational needs. Unlike the old retired persons or pensioners, they are totally dependent. It is their right to get all the facilities like health, nutrition, medical care and education during this period to be able to discharge their duties in adult life. Child labour is banned all over the world for this very reason. Unfortunately a large number of male and female children in our country are compelled to work and that too very rigourously and often in unhygienic conditions for very paltry sums. Instead of their parents supporting them they are required to take care of their parents—sacrificing their joys and benefits of childhood.

In Japan on the other hand the age composition is as follows:

Age	*Per cent*
0 - 14	23.5
15 - 64	67.2
65 years and above	9.3

The dependency ratio of Japan is only 48.8 as against 83 in India. In Japan old persons are well protected by old age social security benefits which they have earned during their active life.

Unemployment is very low and women are in jobs in a very big way. The per capita income and personal consumption are bound to be high in such a socio-economic structure. In our country the situation is very different.

The Cultural Composition of the Population

Ethnically, India consists of several races—the important ones among them being the Dravidians, the Mongloids and the Aryans, along with Caucasians. In course of time these races have intermingled, losing many of their original traits and acquiring new ones from others. And yet we notice a great diversity which is so characteristic of the Indian people. In fact, the richness and beauty of Indian culture lies in its diversity. Its spirit of tolerance, give-and-take and assimilation makes it one of the distinctive cultures of the world. The Indian people follow different faiths, cutting across regional, political and linguistic barriers. They speak different languages, which in turn cut across races, religions, castes and often regions. Notwithstanding these racial, religious, linguistic and regional diversities, we are all indians first and Indians last. Ours is a plural society with a composite culture that can be compared to a fine mosaic or to a garden with flowers of various colours and shades of which, while maintaining their own entity, lend colour and beauty to the garden.

of trade in our favour. Do you notice a large number of items in which our production has increased considerably but which do not figure in our export lists? This is because of our own evergrowing home market. Do you justify the rapid growth in our iron-ore exports? Is it not interesting that we import large amounts of precious stones and cashew nuts and export them again? What are we really exporting? Apparently those items but something else of greater significance which we have in abundant measure, namely human skills.

Let us move from exports and imports to the gateways through which they have to pass, namely our ports that give access to oceans, providing links with other continents or far-off lands.

Major Ports

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

Kandla in Kuchchh was the first port developed soon after Independence to ease the increased pressure on Bombay port in the wake of loss of Karachi to Pakistan. In order to cater to the north western 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. Bombay 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 in 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. Cochin 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 courty. It handles a variety of cargo including coal, salt, edible oils, chemicals etc. Madras is one of the oldest but artificial port on the east coast. It handles general cargo and ranks next only to Bombay. 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 eighty miles 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 major port has been developed down stream at Haldia. It supplements the facilities available at Calcutta. Haldia handles mineral oil, petroleum products, fertilizers and other dry cargo.

UNIT FIVE

Nurturing Our Human Resources

Humans like any other animal was indeed a creature of environment. Being fragile and almost defenceless, humans soon learnt the advantages of living in groups--clans and families. Although humans started as a mere biological species, they, over a period of time, managed to be a social animal. They developed faith in cooperative living and the art of communication. Curious as they were, first they keenly observed the environment together with various physical phenomena. This helped them in deriving their food from vegetal and animal kingdoms through selection and experimentation, though their natural urge, perseverance and increasing use of intellect, they succeeded step by step, in unfolding the secrets of their environment which once overowed them. Armed with the use of fire and versatile tools they became a much different species. Instead of being simply a part and parcel of the eco-system they began to manipulate environment to serve their interests.

Humans have progressed a lot since then. They have reached a stage of genetic engineering with the help of which they are able to develop improved strains of plants and domestic animals. We have now heavy yielding and early maturing varieties of trees, shrubs, vegetable and flower plants. Poultry, fish, cattle and other domestic animals have now been turned into highly efficient machines as it were to give us far more eggs, proteins, milk, meat and wool, etc. People have thus acquired a much different role and capabilities to derive maximum from their environment and various other species of the eco-system of which they themselves are still inseparable parts. Humans cannot control climate but are able to anticipate and predict various weather phenomena and through preventive measures protect their interests to a certain extent.

A time is not far when humans themselves would be subjected to such changes with far reaching social implications. The first step in this direction has been the newly acquired human ability to plan their families, the number of progeny and the required spacing between them. They are now able to improve their athletic skills, physical stamina and above all, average longevity. A nation that would develop its human resources selectively in a systematic manner and quickly enough will always have an edge over others. The highly industrialised countries have a head start in this direction.

What are the milestones it has to cross in this regard? The milestones to be covered in this regard are universal literacy, health for all, appropriate vocational

...through equality of sexes, and ever increasing use of science, technology and energy to improve productivity of labour. Improved productivity need to be backed with distributive justice to ensure that the fruits of development reach the lowest strata of the society. This is the only way to accelerate the pace of our socio-economic development to be able to survive in this highly competitive world.

1) Better medical facilities
2) Climatic factors.
3) Illiteracy
4) Fertile land
5) Society
6) Religious factor

CHAPTER 9

Human Resources

There was a time when the strength of human beings depended on their numbers alone. In the traditional agrarian society, manual labour was required for most of the work. Therefore, more people meant more production and thereby more prosperity. But this perspective changed with industrial revolution and the consequent developments in science and technology. Use of various kinds of tools, machines and sophisticated technology has reduced the dependence on manual labour considerably. Mechanization brought in speed and efficiency. Hence production increased manifold. For using and operating the sophisticated tools and technology, certain skills and abilities were required. Therefore, quality of people was considered important and gradually more emphasis was laid on the quality, rather than quantity of people.

The population of a country is regarded as a potential resource and includes both quantitative and qualitative aspects. By quality of people we mean their economic efficiency or productivity, the level of their scientific and technological development, their cultural values and their social and political organizations. The growth and development of a human being and his/her total personality is rather delicate. It calls for sustained and concerted efforts on several dimensions simultaneously. In the process, a family, society and social institutions like the school have to play an important role. Human resource of a country is to be nurtured carefully in the best possible manner because it would ultimately determine how best the natural resources of that country can be developed. In this context, education, health, skill development, and proper work ethic and character building inclusive of social sensitivity have acquired over-riding importance.

A few tables are given against the above-mentioned perspective. They would throw up many points for you to ponder over and arrive at your own conclusions.

Our Population Growth

You have already seen three phases of population growth over nine decades— negligible, moderate and rapid. During the first phase of 20 years, it grew at a pace of 0.26 per annum. In the next 30 years the population growth rate was a little over one per cent per annum. In the last decade of the third phase, the growth rate jumped to 2.14 per cent per annum. In fact in just 34 years after Independence another India was added while the territorial limits of the country remained unchanged. Population grows exponentially like compound interest. With one per cent growth it does not take 100 years to double itself. It does so in just 70 years, while with 2 per cent growth

FOR DOING IT YOURSELF

TABLE 9.1

Total Population, Average Density of Population and Urban Population in India from 1901 to 1991

Year	Total population (in million)	Density of population (per sq. km.)	Percentage of urban population to total population
1901	238	77	10.84
1911	252	82	10.29
1921	251	81	11.18
1931	279	90	11.99
1941	318	103	13.86
1951	361	117	17.29
1961	439	142	17.97
1971	548	177	19.91
1981	685	216	23.34
1991	844	267	25.72

(i) Name the two decades when population was rather stable with negligible growth. Work out the net addition in twenty years. Find out average annual addition in lakhs for this twenty-year period.

(ii) State the three decades showing rather moderate growth of population. Calculate the net addition in thirty years. Work out average annual addition for this thirty-year span.

(iii) Mention the four decades with very fast growing population. Calculate the total net addition for forty years. Find out how many millions were added on an average every year.

(iv) Identify two separate decades which had sudden spurts in urban population. Find out the possible reasons thereof.

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	9,976,600	26.5	3
3.	China	9,597,000	1134.0	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.

TABLE 9.3

Some Demographic and Other Related Indicators of a Few Countries including India

S.No	Country	Literacy Rate	Infant Mortality Rate	Birth Rate	Death Rate	Natural Increase	Life Expectancy Male	Life Expectancy Female
1.	Bangladesh	N.A.	128	44.8	17.5	27.3	55.3	54.4
2.	India	52.2	80	29.5	9.8	19.7	55.6	56.4
3.	Sri Lanka	N.A.	32.9	24.8	6.5	18.3	67.8	71.7
4.	China	N.A.	39.0	19.0	6.7	12.3	67.7	68.9
5.	Japan	99.9	6.0	12.5	6.2	6.3	74.5	80.2

(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.

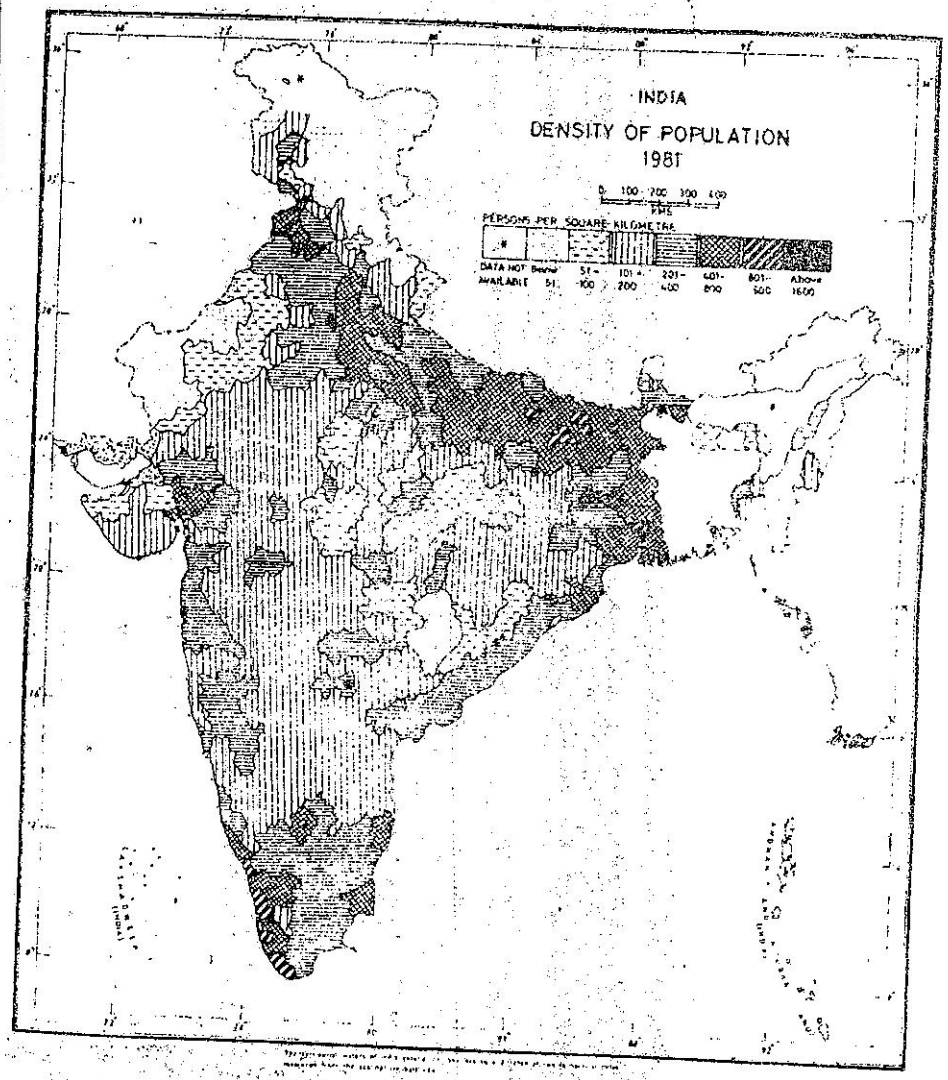
rate it takes merely 35 years. This is the rate at which we have been doubling ourselves.

We know that India has only 2.4 per cent of the world's land area over which we are now required to sustain our population which in the year 1991 was about 16 per cent of the world's total population. Our average density of population is over six times the world's average. You can imagine how crucial is this problem.

Distribution of Population

Look at the map of population distribution in India. The overall distribution of population generally corresponds with the soil fertility. The thickly peopled parts of India are the northern plains, the coastal deltas along the Bay of Bengal and coastal plains of the west coast including the plains of Gujarat. The density of population, by and large, is more in well watered parts of India and population goes on decreasing with growing aridity from east to west. West Bengal is the most densely peopled. The density decreases in the plains of the Punjab and Haryana. Kerala has a high density of population closely associated with ample rains enabling two to three crops a year and with abundant fish supply from its backwaters and deep seas.

The sparsely peopled parts of India are



9.1 India—Density of Population

Note the densely populated parts of India. Which areas on the map show a population density less than the national average?

the high mountain regions of the north, rainy forested lands of north-east frontiers and extremely arid lands of western Rajasthan extending up to Kachchh in Gujarat. The rocky and hilly regions of peninsular India including the Vindhyas and their eastern extensions are moderately populated parts of our country.

The Rural Urban Divide

India has the reputation of being a country essentially of villages, their number being over half a million. In the beginning of the century, nine out of ten persons lived in villages. The total urban population was nearly 26 million. By 1983 the total population of India increased more than 3 times. But the urban population rose by as much as eight times. Now one out of every four persons is an urbanite. To put it the other way round, for every city dweller there used to be nine villagers. Now there are only three villagers for every city dweller. In the first forty years the share of urban population improved just by three per cent. But in the next 50 years its share rose by 12 per cent–from 14 per cent to 26 per cent. The urban population of India in 1991 stood at 217 million. This number is more than that of the fifth most populous country of the world, the Island Empire of Indonesia, or even more than that of Brazil's total population.

In 1991, nearly 65 per cent of the total urban population lived in class I cities and towns with a population of one lakh and above. There were 300 such towns in 1991 as against 106 just 30 years ago. This trend of concentration of large urban population in big cities is highly alarming. Again if 300 cities account for 139 million of urban population 23 metropolitan cities cornered among themselves half of this population, viz. 70 million. Obviously this upsurge in population growth has put great strain on the existing resources and services available in cities and people are at times devoid of basic amenities. The situation in villages is also deteriorating. The landless peasants are gradually being marginalised. Even though the marginal farmers have a partial claim to their parental land holdings, these become uneconomic or non-viable, mainly due to their fragmentation. A steady increase in such non-viable land holdings results in making several small farmers surplus and they are pushed out to join the groups migrating to big cities.

The following table demonstrates how village people are being increasingly pushed to big cities. While in 1981, there were 12 metropolitan cities with a population of over 1 million, in 1991, their number increased to 23. Look at the fast pace at which they have been exploding rather than growing.

TABLE 9.4

Population in top ten (million plus) cities, 1991

Rank	*Metropolis*	*Population in 1991 (in million)*	*Growth rate 1981-91 (in %)*
1.	Greater Bombay	12.6	33.43
2.	Calcutta	10.9	18.73
3.	Delhi	8.4	46.18
4	Madras	5.4	24.99
5.	Hyderabad	4.3	67.04
6.	Bangalore	4.1	39.87
7.	Ahmedabad	3.3	28.94
8.	Pune	2.5	47.38
9.	Kanpur	2.1	28.81
10.	Nagpur	1.7	36.24

group comprises old people returning back to the category of non-workers.

The division of population into these groups is known as population pyramids. A comparison of population pyramids of different societies is found very useful.

In India as per 1981 census this three-fold division was as follows:

Age	*Per cent*
0 - 14	39.5
15 - 59	54.3
60 and above	6.2

Taking the first and third group together i.e. 45.75 per cent of our population is bracketed as dependent population. The remaining i.e. economically active population of 54.3 per cent has to suppport this dependent population. The proportion between the two is termed as *dependency ratio*. In India it is 83. That means every 100 persons in the age group of 15 to 59 have to support 83 persons who are dependent on them. Again, it must be noted that children below 15 years of age are bound to be highly demanding in terms of their nutritional, health and educational needs. Unlike the old retired persons or pensioners, they are totally dependent. It is their right to get all the facilities like health, nutrition, medical care and education during this period to be able to discharge their duties in adult life. Child labour is banned all over the world for this very reason. Unfortunately a large number of male and female children in our country are compelled to work and that too very rigourously and often in unhygienic conditions for very paltry sums. Instead of their parents supporting them they are required to take care of their parents—sacrificing their joys and benefits of childhood.

In Japan on the other hand the age composition is as follows:

Age	*Per cent*
0 - 14	23.5
15 - 64	67.2
65 years and above	9.3

The dependency ratio of Japan is only 48.8 as against 83 in India. In Japan old persons are well protected by old age social security benefits which they have earned during their active life.

Unemployment is very low and women are in jobs in a very big way. The per capita income and personal consumption are bound to be high in such a socio-economic structure. In our country the situation is very different.

The Cultural Composition of the Population

Ethnically, India consists of several races—the important ones among them being the Dravidians, the Mongloids and the Aryans, along with Caucasians. In course of time these races have intermingled, losing many of their original traits and acquiring new ones from others. And yet we notice a great diversity which is so characteristic of the Indian people. In fact, the richness and beauty of Indian culture lies in its diversity. Its spirit of tolerance, give-and-take and assimilation makes it one of the distinctive cultures of the world. The Indian people follow different faiths, cutting across regional, political and linguistic barriers. They speak different languages, which in turn cut across races, religions, castes and often regions. Notwithstanding these racial, religious, linguistic and regional diversities, we are all Indians first and Indians last. Ours is a plural society with a composite culture that can be compared to a fine mosaic or to a garden with flowers of various colours and shades of which, while maintaining their own entity, lend colour and beauty to the garden.

India is the home of Hindus, Muslims, Christians, Sikhs, Buddhists, Jains, Zorastrians, and others. None of these people enjoy any special privileges on the ground of their religion. Nor do they suffer in economic, political or social life because of their faith in a particular religion. All are equal before law and enjoy full freedom. All are bestowed with equal rights, entailing corresponding responsibilities.

In India there are a large number of languages. Some of them are derived from Sanskrit while others are of Dravidian origin. The major Indian languages are Assamese, Bengali, Gujarati, Hindi, Kannada, Kashmiri, Konkani, Malayalam, Manipuri, Marathi, Nepali, Oriya, Punjabi, Sanskrit, Sindhi, Tamil, Telugu and Urdu. Of these four languages of southern India—Tamil, Telugu, Kannada and Malayalam, are of Dravidian origin. However, it would be a mistake to conclude that everybody speaking any of these languages is Dravidian by race. Similarly, not all who speak languages of Sanskrit origin are Aryans. Generally, the people who lived in a given area over a long period of time adopted the language of that region as their first language irrespective of ethnic or any other considerations. Find out the areas in which these Indian languages are spoken. A very large number of people speak Hindi. Similarly, a large number of people are able to understand this language even if it is not their mother tongue. This has led to the adoption of Hindi as the official language of the Union Government. For the convenience of the non-Hindi-speaking states English is also used officially. Linguists are of the view that the Indian languages and their literatures have much more in common than their apparent or outward differences. All the Indian languages are phonetic in nature and have a more or less common structure and a surprisingly large common vocabulary. There is not much difference in the scripts of many of these languages.

We have to move hand in hand towards the common goal of building a strong, united and prosperous India wedded to the ideals of democracy and socialism. We are eager to see our country occupy its rightful place in the comity of nations. Also, we want to contribute towards world peace and prosperity. This calls for organized and sustained efforts in harnessing every available resource for the good of all. It is equally necessary that no section of the society is allowed to exploit others.

Why is Our Population Growing?

The pace of natural increase in population depends upon a gap between the birth rate and the death rate. Bigger the gap, the higher is the growth rate, and the smaller the gap, the lower it is bound to be

TABLE 9.5

Population Growth in India 1901-91

Decade	*Birth rate*	*Death rate*	*Natural increase*	*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	46.4	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	19.2	2.14

Let us have a look at the birth rates. The highest birth rate was in the first decade (1901-11) when it was 49.2. Since then it has come down very slowly and haltingly at times even reversing back to the higher side. The lowest was 32.7 in 1985. Thus the total fall was hardly 35 per cent. On the other hand the behaviour of the death rate is quite different. From 47.2 during 1911-21, it has come down to 11.7 per cent. Thus there has been no rise either in the birth rate

Human populations are catalytic agents of change and development. They are the producers of goods and services, which are only means to an end, namely satisfying their needs and requirements and providing them with comforts and amenities of life. Thus human beings are both producers as well as consumers. The degree to which these needs are satisfied, determines the material level.

Occupational Structure

The occupational structure of our population is very lop-sided. Two-thirds of our population still lives on agriculture. In Japan this primary sector has only 10 per cent of its total working population. Those in the field of industry or manufacturing constitute only 10 per cent of the total working population. The rest i.e. one-fourth of our population is in the tertiary or service sector. This occupational composition makes it clear that a very small proportion of our population is directly engaged in "value addition" tasks that belong to secondary sector of economy. As a result, our total national income remains at a very low level. We shall have to change the current occupational structure by inducting more and more people into the manufacturing sector to bring in the needed prosperity to our country. As efficient producers they have to be productive citizens eager to improve their productivity. This is how they can satisfy their own needs and also contribute to the nation's wealth. In order to understand the nation's potential to take care of these goals, a mere discussion of total population, its density and distribution is not enough. One has to go into the structure and salient features of bution, sex ratio, age composition, growth rate and the health and education status.

The Status of Female Population : Sex Ratio

Human population consists of two components—female and male. The numerical proportion between the two is known as sex ratio. It is stated as the number of females per 1000 males. In our country for the past several decades males have been increasingly outnumbering females. While in 1901 there were 972 females for every 1000 males, in 1971 their number came down to as low as 930. This downward trend seem to have been arrested in 1981 as it rose to 933 but in 1991 it came down to 929. Indian society has certainly to go a long way to convert the unfavourable sex ratio into a favourable one which every civilized society of the world possesses. For instance in Japan it is 1038 females per 1000 males. However, there are intra-regional variations in the sex ratio within our country as well. Only Kerala has a favourable sex ratio equal to that of Japan i.e. 1040 females to 1000 males. Why should it be so ?

With unfavourable sex ratio, the female life expectancy too had been low as compared with the males. But the figures of 1981 census have shown that now females were a shade better. The average life expectancy at birth for females was 56.4 against 55.6 for males. Again in Kerala it was far better: 69.87 for females and 65.23 for males. Thus on an average a Kerala woman lived longer than her male counterpart by four and a half years. Certainly, with increased network of Public health and medicare system, we have made tremendous progress. At the beginning of this century both males and females could expect to live on an average hardly for 23 years. In Japan a female has an average life expectancy of 80 years i.e. six years more than her male counterpart.

There are a number of factors that influence longevity of human beings. Literacy is one of the most significant factors. In 1991 the female literacy in our country was as low as 39.29 per cent as compared to 64.13 per cent for the males. And Kerala which leads the country both in literacy and life expectancy, had 86.19 per cent literacy among its female population. At the beginning of this century only 6 out of one thousand females were literate. After 90 years of efforts, there was sixty times improvement as in 1991 there were 392 literate women per thousand population. However even now 3 out of every five females in India are illiterate. When they cannot read and write their own names, how can we expect them to know the importance of sanitation, hygiene, nutrition, pre- and post-natal care on scientific lines? We should take note of the fact that all advanced countries have overcome sex differential in this crucial area by totally wiping out female illiteracy.

With regard to the economic participation, in 1981 only 14 per cent of the females were engaged in active labour force. Nearly half of them were agricultural labourers and one-third of them cultivators. Thus about 80 per cent of the females were in unorganized sector working for meagre wages and being denied any old age security. In contrast, about 48 per cent of the females above 15 years of age in Japan are active participants in the country's labour force. This has been mainly because of the availability of free and compulsory education to every Japanese between six and fifteen years of age. The actual attendance (and not mere symbolic enrolment) is 99.98 per cent.

While in developed countries like Japan, only 1 out of 20 married women between 15 and 45 years of age is a nursing mother, in India this ratio is as high as 1 to 7. In Japan 50 per thousand women are nursing mothers whereas in India it is 145.2 per thousand. Infant mortality rate i.e. death of children below one year of age per thousand live births is also high in India. The comparable figures of India and Japan are 80 and 6 respectively. The incidence of maternal mortality, i.e. death of women during child birth or soon after due to related complications, is very high in our country. Unfortunately all these problems are closely associated with our social perception and traditional outlook wherein, women were mainly confined to homes, and early marriages were encouraged.

It has been experienced by several countries that with education female participation in the labour force increases, and the age of marriage is also raised. This has an inverse relationship with the fertility rate, i.e. average number of children born to a woman during her reproductive period, maternal mortality rate and infant mortality rate.

In our country a girl's marriage below 18 years of age and that of a boy below 21 years of age is prohibited under law. This however needs to be enforced strictly.

Age Composition

After having seen various implications of sex ratio, let us move to another aspect of population—its age composition and the economics of it.

Population is generally divided into three groups (i) below 15 years of age, (ii) between 15 and 60 years of age, and (iii) above 60 years. The first group is that of children supposed to be entirely dependent on their parents. The second group consists of adults or workers who are supposed to be economically independent. The third

or in the death rate. Both of them have been falling but at a differential pace. While the death rate has been tumbling down, the birth rate has been doing so too slowly to keep pace with the rapidly falling death rate.

The sharply falling death rate is due to success mainly on health front, supplemented by spread of education. But we have not been able to bring down birth rate because of our age-old value system. With growing awareness and proper education, desired results may be achieved. Can small national population and big families ever go together? Prosperity arrives only where the nation and families both move in one direction. Population can be stabilised in the long run only if every family will have no more than two children who would fill in the vacuum created by parents as and when they pass away. This is why we speak of a two child family as a national norm. On the other hand, the People's Republic of China has decided at least for a few decades to come, to have one-child family as a national norm so that over a period of time they would be able to have the total population reduced by half as early as possible. Thus a time is not far when India's population would exceed that of China along with all its serious consequences. It would be only to the advantage of China. It would raise its real economic and technological strength, which is already greater than that of our country.

Education and Health Status

One of the basic inputs in human resource development is education. Literacy and numeracy form the foundation on which the superstructure of education is built. At the time of Independence only 14 per cent of the people were literate. It meant that they could at least read and write their names. By 1991 it has slowly risen to 52 per cent. In absolute terms, the number of the literates has grown to 437 million from 60 million. It is more than a sevenfold growth. But it is pertinent to note that the number of illiterate persons has not decreased. From 300 million in 1951 it has risen to 407 million by 1991.

Our constitution directed the government to provide education for all children up to the age of fourteen. This was a big task because the bulk of the population was distributed over half a million villages separated by considerable distance from one another. Priority was, therefore, given to set up schools in almost every village. As a result there are now over half a million primary schools in place of two lakhs in 1951. Similarly the middle schools also increased by as much as ten times. Earlier there was one middle school for every 15 primary schools. Now it stands for every four primary schools. Although there has been a marked increase in the number of children getting into formal schools, one of the worries is that out of every 100 children in Class I, only 40 manage to complete Class V, and 25 reach Class VIII. Thus three-fourths of the pupils still drop out on their way before they are able to reap advantage of education visualised for everyone under our constitution.

We have also made progress in increasing the number of secondary schools, universities, industrial training as well as other institutions. Still educational facilities are not available to all because of fast growing population.

Spectacular rise in life expectancy at birth is obviously due to an enlarged network of improved *health care* facilities all over the country. With the spread of education, the health consciousness of the people has been gradually improving.

Three-fold increase in the food production should have considerably increased

the per capita availability of foodgrains. In 1951 it was 395 grams per day per person, which rose to 478 grams in 1986-87. In this connection two facts need to be noted. First, the population itself has more than doubled, and secondly, at least a third of our population living below poverty line, are unable to buy their requirements of food even if stocks are ample.

At present, there is one hospital for one lakh people, and one hospital bed for 1400 population. This situation is not encouraging. Today most of the killer diseases are waterborne in nature. Therefore, safe drinking water in every village needs highest priority. Since Independence we have succeeded in wiping out small-pox and controlling serious diseases like cholera, malaria, tuberculosis etc. In order to provide better health facilities to all, the government is trying to provide integrated package of health care services. It includes taking care of expectant mothers and young children.

Today we are having an ever-increasing population. They are not mere numbers. They have a natural urge and a keen desire to raise their standards of living. This implies more and more consumption of our limited resources. This calls for greater awareness on our part to maintain our environment and conservation of limited natural resources. In other words, our approach to our environment and resources should be scientific. While fulfilling our needs we must ensure that our resource base remains intact and is not destroyed. We must remember that it is not so much of an inheritance from the past. It is in fact a sacred trust that rightly belongs to generations that are yet to come.

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) Which are the two most populous countries of the world?
   (ii) Which languages of India are of Dravidian origin?
   (iii) What are the common features of Indian languages linguistically?
   (iv) What is meant by dependent population?
   (v) What is the rate of population growth in India?
   (vi) Can we reduce the population growth rate by providing better educational opportunities to women? How?
   (vii) What is a population pyramid ?
   (viii) How does the population pyramid of India compare with that of Japan?
2. Give a technical term for each of the following statements:
   (i) number of females per 1000 males
   (ii) number of persons per square kilometre of total surface area
   (iii) number of infants dying under one year of age per thousand live births in a year
   (iv) persons engaged in some useful occupation for earning their living and contributing to a productive economic activity.

3. Given below are the four problems we are confronted with. Which one of them should be of utmost concern and why?
   (i) the total population of India
   (ii) its unabated growth rate
   (iii) rapid urbanization in India
   (iv) high dependency ratio in India
4. Write an essay on population distribution in India pointing out geographical factors influencing the same.
5. Discuss in what ways the population scenario in Kerala is different from the nation as a whole. What conclusions would you arrive at?
6. Write a brief account on the impact of rapid urbanization in India.

Map Work

7. 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