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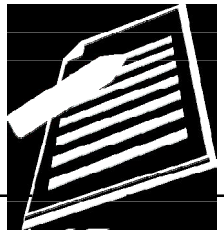
23

DEVELOPMENT OF MINERAL AND ENERGY RESOURCES

In the previous lessons, we have read about land, soils water and forests resources. In this lesson, we will study another two vital resources namely minerals and energy resources. Minerals like land and water are invaluable treasures of the earth. Without them, we cannot think of industrialisation and hence the development of our economy. In many countries, they are the main source of national income. The social and economic development of a nation depends on its capacity to utilise its natural resources, avoiding its wasteful use to the extent possible. The most important characteristics of minerals which have bearing on our present and future well-being is that they are practically lost, once used. They are non-renewable resources. Hence, the need to conserve these resources and to recycle them cannot be over emphasised.

Among the many causes of the fall of the Roman Empire, the depletion of the mineral deposit and the erosion of soil is said to be one. Even during the recent past, several mining towns turned into 'ghost towns' in many parts of the developed world. The Canadian township of Elliot Lake which turned out to be "the first nuclear-age ghost town" is the most recent example of this process. Built at an enormous cost in response to the discovery of uranium in mid fifties, its population declined from 25,000 in 1958 to 5,000 in 1961 as soon as an alternative source was found by the U.S.A. It only shows that prosperity based exclusive on mineral and energy resources cannot be taken for granted as permanent.

In this lesson, we will be studying some of the important minerals, mineral fuels and other energy resources, their geographical distribution, problems associated with these resources and the need for their conservation.



OBJECTIVES

After studying this lesson, you will be able to:

- state about the mineral resources of the country;
- explain the importance of minerals and energy resources for the economic development;
- differentiate between (i) metallic and non-metallic minerals, (ii) conventional and non-conventional resources of energy
- locate on the outline map of India, the different areas where mineral and energy resources are found.
- infer the effects of mining/refining and using of fossil fuels on local environment; and
- suggest measures to conserve minerals and energy resources.

23.1 MINERAL RESOURCES OF INDIA

India is richly endowed with minerals. Our country possesses more than 100 minerals. Out of 100 minerals, there are 30 minerals which have economic significance. Some of the examples are coal, iron ore, manganese, bauxite, mica etc. The situation is also satisfactory in felspar, florides, lime-stones, dolomite and gypsum etc. But the reserves of petroleum and some nonferous metallic minerals especially copper, lead, zinc, tin, graphite are inadequate. Non-ferous minerals are those which do not contain iron. Country fulfills internal demands for these minerals by importing them from other countries.

As you have read in the history, India was least industrialised and most of the minerals were exported during British period. After independence though export continues but also mineral production has picked up in consonance with the increasing industrial demands in the country. As a result the total value of all minerals produced in the country reached about Rs 744 billion in 2004 – 05 from Rs 892 million in 1950-51. Therefore, there has been 834 times increase during the past fifty five years. If we look at mineral wise break up it has been found that fuel minerals (coal, petroleum, natural gas and lignite) accounted for about 77%, metallic minerals for about 10% and non-metallic minerals for about 3% of total value of minerals produced. In metallic mineral category, iron ore, chromite, manganese, zinc, bauxite, copper, gold are important minerals whereas in non-metallic category lime-stone, phosphorite, dolomite, kaolin, magnesite, barytes and gypsum are important. If we look at individual minerals in terms of value, then coal (36.65%) followed by petroleum (25.48%), natural gas (12.02%), iron ore (7.27%), lignite (2.65%), lime stone (2.15%) and chromite (1.1%) are the

few minerals that contributes more than one percent each of the total value of all minerals produced in the country.

Till now we have a detailed discussion about the minerals that are found in our country, their economic significance. In the next section, we will find out their geographical distribution.

23.2 SPATIAL DISTRIBUTION OF MINERALS AND ENERGY RESOURCES

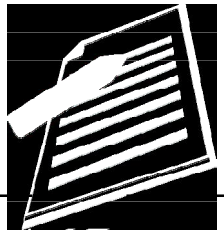
The distribution of mineral and energy resources is uneven. It's because occurrence of mineral resources are associated with certain types of geological formation. Coal deposits are mostly associated with Gondwana system, Dharwar and Cuddapah systems contain resources of major metallic minerals like copper, lead, zinc etc and major non-metallic minerals like limestone, dolomite, gypsum, calcium, sulphate etc are found in cuddapah and upper vindhyan system.

If we look at the distribution in terms of region, then it has been found that much of the peninsular region west of a line from Mangalore to Kanpur has very little mineral wealth. East of the line which covers the state of Karnataka, Andhra Pradesh, Orissa, Madhya Pradesh, Chhatisgarh, Jharkhand, Bihar and West Bengal. These states have the major reserve of metallic minerals like iron, bauxite, manganese etc and non-metallic minerals like coal, limestone, dolomite, gypsum etc. Most of these mineral bearing states are located in the peninsular plateau region of India. Within peninsular plateau region of India the following three mineral belts can be demarcated.

(1) **The North eastern plateaus:** It covers chhotanagpur plateau, orissa plateau and eastern Andhra plateau. This belt contains rich deposits of a variety of minerals, speacially used for metallurgical industries. Prominent minerals that are large and widely distributed are iron ore, manganese, mica, bauxite, limestone, dolomite etc. This region has also rich deposits coal, along the river valleys of Damodar, Mahanadi, Son etc. This region has also substantial amount deposit of copper, uranium, thorium, phosphate etc.

(2) **South-western plateaus:** This region extends over Karnataka plateau and adjoining Tamil Nadu plateau and is rich in metallic minerals particularly in iron ore, manganese and bauxite and in some non-metallic minerals. All the three gold mines of India are found in this region. However, coal is not found in this plateau region.

(3) **North-western region:** This belt extends from gulf of Khambhat in Gujarat to the Aravalli range in Rajasthan. Petroleum and natural gas are principal resources of this belt. Deposits of other minerals are small and scatterred. However, it is known for reserves and production of several non-ferrous metals particularly copper, silver, lead, and Zinc.



Outside of these mineral belts, upper Brahmaputra valley is a significant petroleum producing area whereas Kerala possesses enormous concentration of heavy mineral sands. Outside these above mentioned areas minerals deposits are very poor, scatterred and reserves are inconsistent.

In the next section we will discuss about mineral fuels and mineral. Under mineral fuel we will discuss coal, petroleum, natural gas, and atomic minerals namely uranium and thorium. Under minerals certain selective minerals under ferous and non-ferous categories will be discussed.

23.3 MINERAL FUELS

Mineral fuels include coal, petroleum, natural gas and atomic or radio-active minerals.

(a) Coal

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

As per the assessment of January, 2005 the total coal reserves of the country stand at 2,47,847 million tonnes. Unfortunately, the bulk of the Indian coal reserves are of rather poor quality. We meet part of our coking coal requirements through import. In India, emphasis is being laid on setting thermal and super thermal power station on or near the coal fields and electricity generated is supplied to far off places through transmission lines. At one time Indian railways were the largest consumer of coal. Since they have switched on to the use of diesel and electricity they are no more the direct consumer of coal.

Table 23.1 Production of Coal in India (including Lignite)

Year	Production (in Million Tonnes)
1950-51	32.8
1960-61	55.7
1970-71	76.3
1980-81	118.8
1990-91	225.7
2004-05	376.63

Source: India 2006, A Refrence Annual, P. 276

Distribution

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

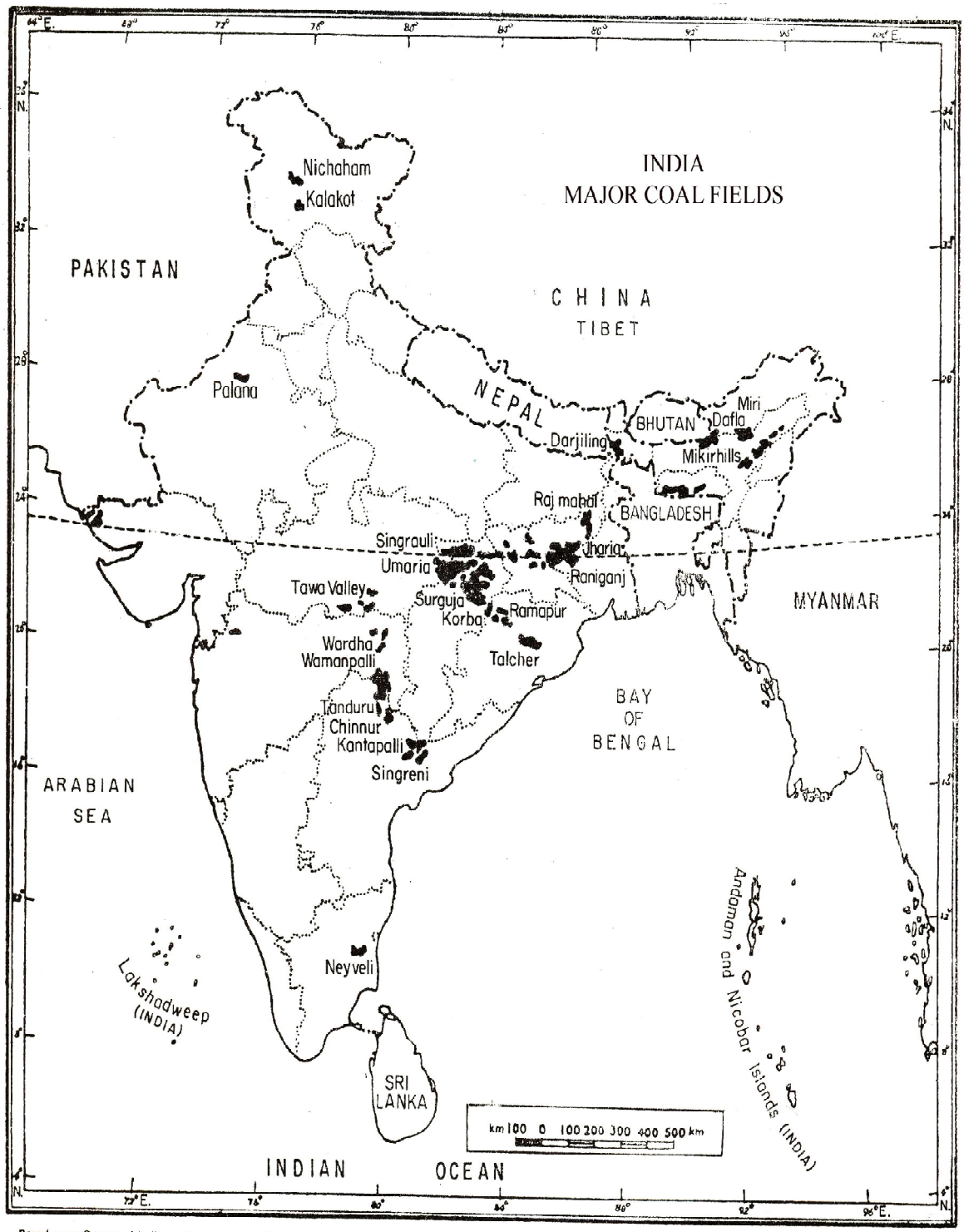
Jharkhand ranks highest in production as well as reserves of coal in India. The coal deposites of Jharkhand mainly occur in Dhanbad, Hazaribagh and Palamau district. In Dhanbad district the most important coalfields of Jharia and Chandrapura are located. The oldest coal fields of Raniganj is situated in West Bengal. It is the second largest coalfield in India. Raniganj coalfield stretches over Burdwan and Purulia districts. In Chhatisgarh, coal deposits occur in Bilaspur and Sarguja districts. In Madhya Pradesh, coal deposits are found in Sidhi, Shahdol and Chhindwara districts. Singrauli coalfield in Shadhol and Sidhi districts is the largest in the state. In Andhra Pradesh, coal occurs in the district of Adilabad, Karimnagar, Warangal, Khammam and West Godavari. In Orissa, Talcher is an important coal field. Other coal field are in Sambalpur and Sundargarh districts. In Maharashtra the coal fields are found in the districts of Chandrapura, Yeotmal and Nagpur.

In comparison to India’s coal reserves, lignite reserves are relatively modest. The bulk of lignite reserves are located in and around Neyveli in Tamil Nadu. Significant lignite reserves are found in Rajasthan, Gujarat, Pondicherry and Jammu & Kashmir.

- Coal is used as raw material in chemical and fertiliser industries and in the production of thousands of items of daily use.
- Coal are mainly found in the Gondwana and Tertiary coal field.
- The states of Jharkhand, West Bengal, Chhatisgarh, Andhra Pradesh and Orissa are the leading producers of coal.
- The bulk of lignite reserves are found in and around Neyveli in Tamil Nadu.

(b) Petroleum

Petroleum has often been called liquid gold because of its value in our modern



Based upon Survey of India outline map printed in 1979.

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. 23.1 INDIA : Major coal fields

civilization. Our agriculture, industry and transport system depend on petroleum in several ways.

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

Distribution

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

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

- Petroleum occurs in anticlines and fault traps. In India it is found in sedimentary rocks. Most of such areas lie in the Assam, Gujarat and off shore areas along the western coast.
- Petrol, kerosene, diesel, detergents, synthetic fibres, plastics, cosmetics etc. are important products derived from petroleum.
- Petroleum products are used a fuel, lubricant material for manufacturing synthetic derivatives and chemicals required in industries.

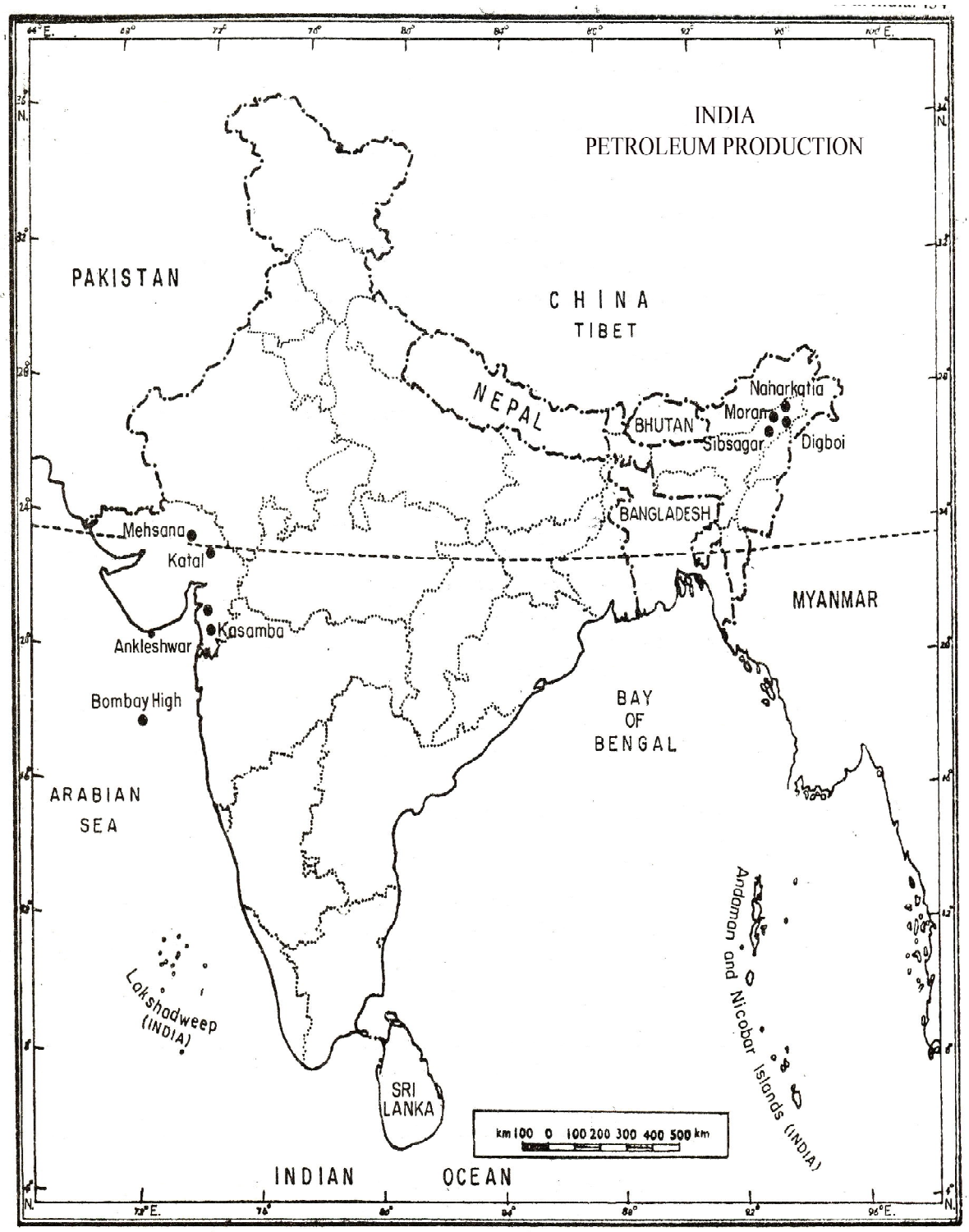


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Fig. 23.2 INDIA : Petroleum production

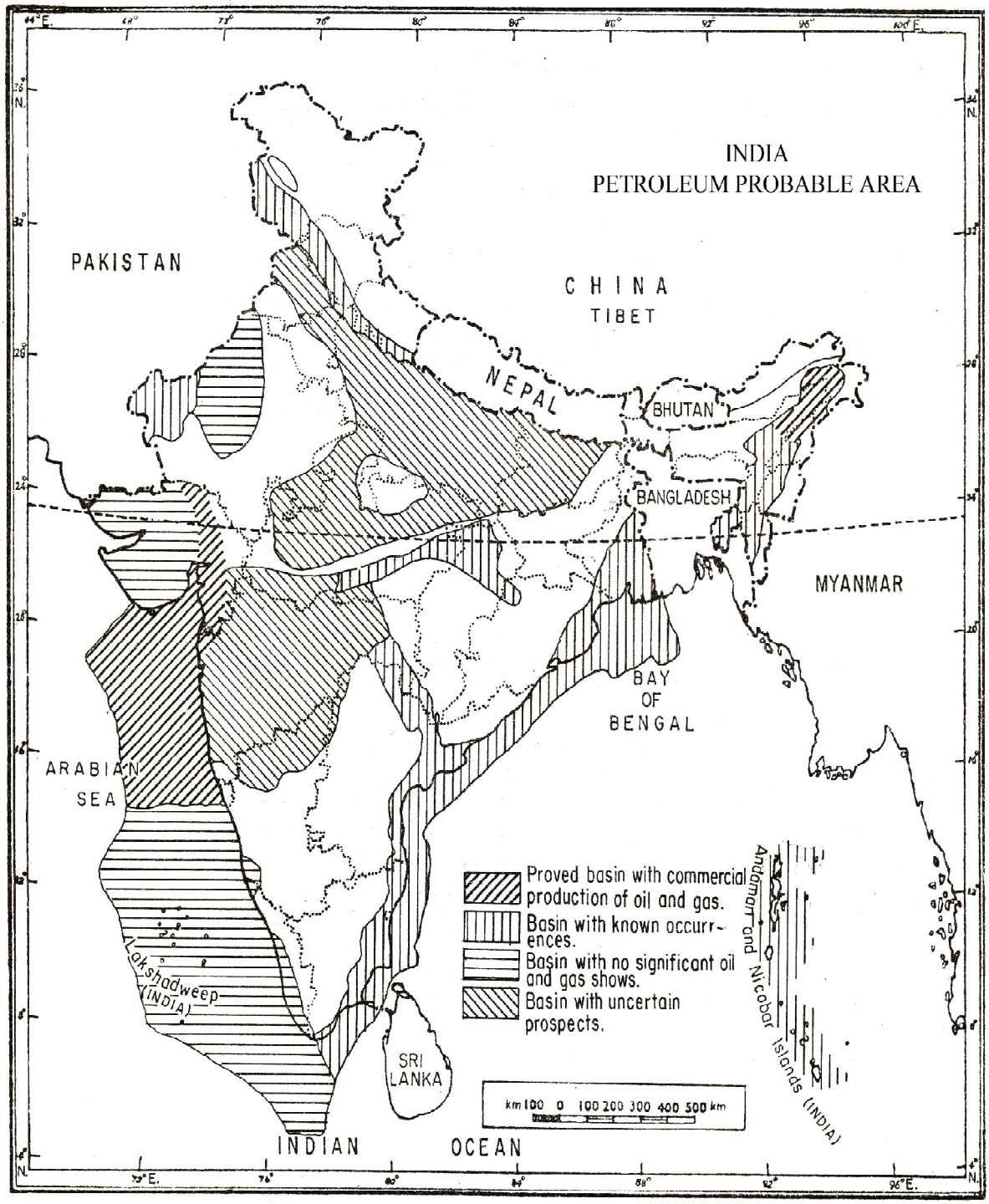

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Fig. 23.3 INDIA : Petroleum probable Area

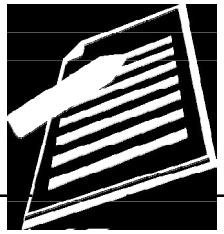


Table 23.2 Production of Crude Petroleum in India

Year	Production (in million tonnes)
1960-61	0.5
1970-71	6.8
1980-81	10.5
1990-91	33.0
2000-01	32.4
2005-06	32.2

Source : Economic Survey 2006-07, S-1

Oil Refineries in India

The crude petroleum taken from oil fields needs to be refined before it can be used. Oil refining is really a big chemical engineering industry involving a complicated process. Presenty there are 17 oil refineries in India under public sector and one in private sector which belongs to Reliance Industries Ltd. These refineries are at Digboi, Bongaigaon, Nunamati (All are in Assam), Mumbai (two) (Maharashtra), Vishakhapatnam (Andhra Pradesh), Barauni (Bihar), Koyali (Gujarat), Mathura (U.P.), Panipat (Haryana), Kochi (Kerala), Mangalore (Karnataka) and Chennai (Tamil Nadu).The only private oil refineries belongs to Reliance Industries Ltd. is located at Jamnagar (Gujarat). These oil refineries are supplied crude oil either by ships or by pipelines. Although the annual production shows an increasing trend, the country has to import petroleum and petroleum products to meet its requirements.

- Presently, there are 17 oil refineries in India under the Public sector and 1 in private sector.
- Although the annual production shows an increasing trend, the country has to import petroleum and petroleum product to meet its requirement.

(c) Natural Gas

Natural gas is energing as an important source of commercial energy. Most of the time it is found in association with petroleum. The recoverable reserves of natural gas (as on 1st April, 2001) are estimated at 638 billion cubic metres. But this quantity will increase as more and more reserves are discovered at eastern coast namely Krishna, Godavari and Mahanadi basins. Production of natural gas in 2003-04 was about 31 billion cubic metres.

Gas Authority of India was established in the year 1984 with an aim for processing, transporting, distributing and marketing of natural gas. The company owns and operates a network of over 5,340 km of natural gas pipeline in the country.

(d) Atomic Minerals

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

Uranium

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

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

Thorium

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

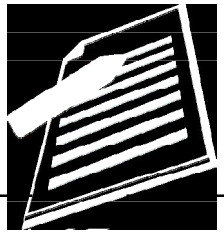
- The production of Uranium is presently confined to the mines of Jaduguda in Singhbhum district of Jharkhand. .
- India possesses the world's largest monazite reserves, the principal source of thorium.
- The beach sand of Kerala in Palghat and Quilon districts contain world's richest monazite deposits.
- In India Uranium is found in the igneous and metamorphic rocks in Jharkhand, Rajasthan, Andhra Pradesh and some parts of Himalaya.

INTEXT QUESTION 23.1

1. Tick (√) the correct alternative from the given with each statement

(a) Which one of the following is the leading mineral in terms of economic value

(i) Coal (ii) Petroleum (iii) Iron ore (iv) Gold



(b) All the three gold fields of the country are found in which region

(i) North-eastern plateaus (ii) South-western plateaus (iii) North-eastern region (iv) North-western region.

(c) Oil refining is done at

(i) Kanpur (ii) Barauni

(iii) Kandla (iv) Masulipatnam

(d) The chief oil fields of India are in

(i) Assam and Gujarat

(ii) Andhra Pradesh and Rajasthan

(iii) Madhya Pradesh and Assam

(iv) Gujarat and Bihar

(e) 80 percent of coal reserves of India are in

(i) Godavari Valley (ii) Wardha Valley

(iii) DamodarValley (iv) Mahanadi Valley

(f) Tertiary coal is found in the state of

(i) Kerala (ii) Jammu & Kashmir

(iii) Bihar (iv) Uttar Pradesh

(g) The largest coal producing coal field is

(i) Raniganj (ii) Jharia

(iii) Bailadila (iv) Talcher

(h) Recently gas reserves are discovered in the basins of

(i) Narmada and Tapi (ii) Ganga and Brahmaputra

(iii) Krishna and Godavari (iv) Damodar & Subarnarekha

23.4 DISTRIBUTION OF SOME IMPORTANT MINERALS

In India mineral resources are very unevenly distributed. Most of the minerals are found in the ancient crystalline rocks of the Deccan and Chhotanagpur Plateau. Some minerals are found in the Himalayan region, although they are difficult to exploit.

Minerals are broadly divided into two groups metallic and non metallic minerals. Metallic minerals are further subdivided into ferrous and non ferrous minerals.

(A) FERROUS MINERALS

Ferrous minerals are those which contain iron in substantial quantity.

(a) Ferrous Metallic Minerals:

Ferrous minerals account for about three-fourth of the total value of the production of metallic minerals. They constitute the most important mineral group after fuel minerals. They include iron, manganese, chromite, pyrite etc. These minerals provide a strong base for the development of metallurgical industries, particularly iron, steel and alloys.

(i) Iron Ore

India is one of the few countries of the world which is endowed with vast reserves of good quality of iron ore. She possesses over 20 percent of the world's total reserves. The quality of Indian ore is very high with iron content of above 60 percent.

Most of iron ore found in the country is of three types :- Haematite, magnetite and limonite. Haematite ore contains up to 68 percent of iron. It is red in color and is often refered to as 'red ore'. Next to haematite in quanitity and richness is the magnetite ore. It contains up to 60 percent of the iron. It is dark brown to blackish in colour, and is often referred as 'black ores', Limonite is the third type of ore which has iron content of 35-50 percent. It is yellow in colour. Since India has large reserves of haematite and magnetite ores, inferior quality ore like limonite is rarely exploited.

The total estimated reserves of iron ore in the country are placed at about 12,857 million tonnes of which12,317 million tonnes are haematite ore and about 540 miillion tonnes of magnetite ore. This is roughly about one fourth of the world reserves.

Table 23.3 Production of iron ore in India

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

Source: India 2006: A Reference Annual, p.571

Distribution

Iron ore deposits are found practically in every state of lndia. However, 96 percent of the total reserves are in Orissa, Jharkhand, Chhatisgarh, Karnataka and Goa. These states also account for 96 percent to the total production of

iron ore in the country. About 3 percent of the country's total production comes from Tamil Nadu, Maharashtra and Andhra Pradesh.

Orissa and Jharkhand together possess about 50 percent of India's reserves of high-grade iron ore. The principal deposits are located in Sundargarh, Mayurbhanj and Keonjhar districts of Orissa and Singhbhum district of Jharkhand.

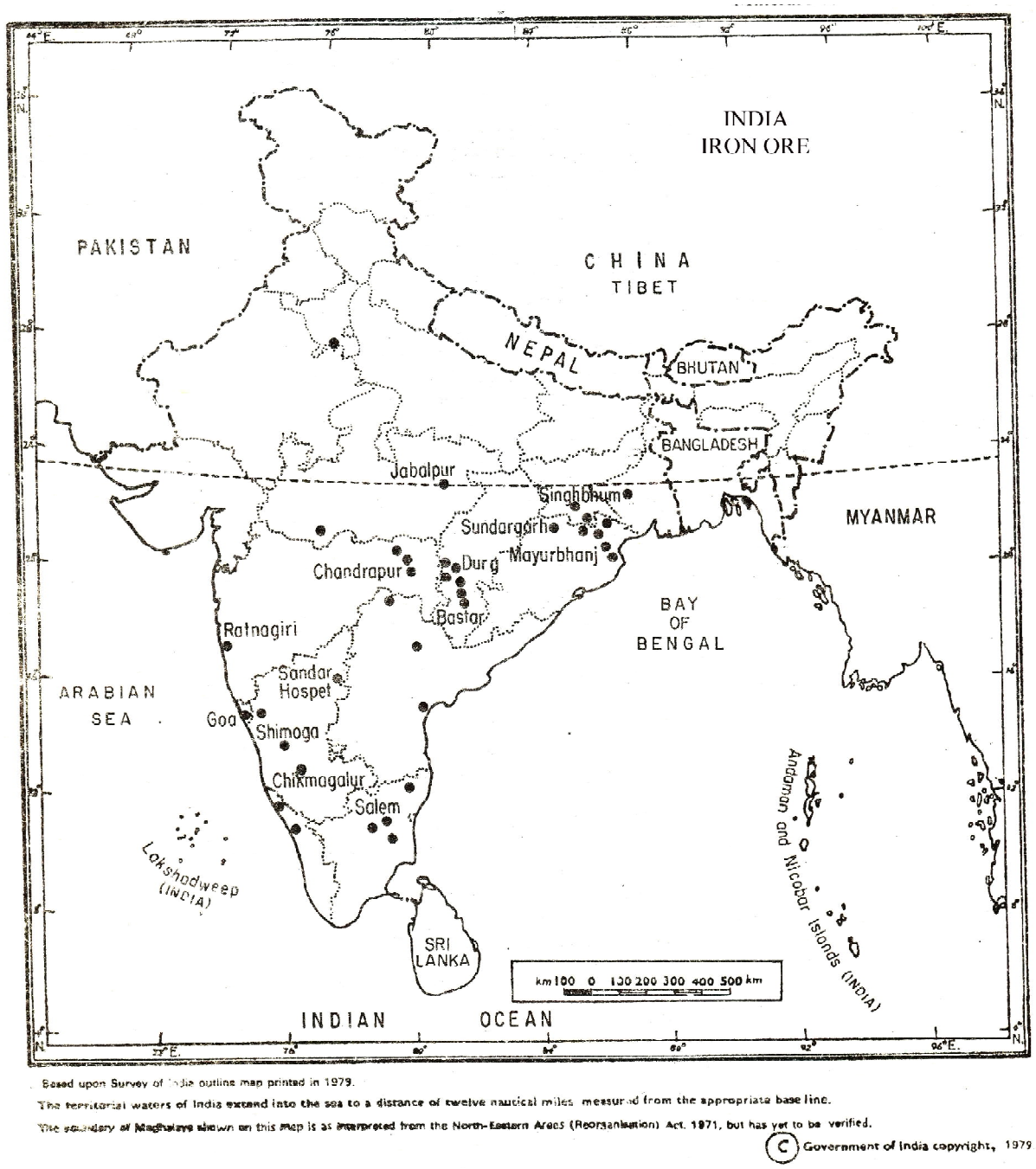


Fig. 23.4 INDIA : Distribution of Iron ore

Chhatisgarh and Madhya Pradesh contributed about 25 percent of country's total iron ore reserves and about 20-25 percent of country's production of iron ore. The reserves are located in Bailadila range, Raoghat area near Aridongri in Bastar district and Dhalli Rajhara range in Durg district.

Goa posseses inferior quality ore but its contribution to the country's total production is impressive. Most of the mines are open cast and mechanized. Almost the entire production of iron from Goa is exported from Marmagao Port to Japan. In Karnataka, the most important deposits are found in the Sandur-Hospet area of Bellary district; Babaudan hills of Chikmagalur district and in Simoga and Chitradurga district.

Iron ore deposits of Andhra Pradesh are scattered in the Anantpur, Khammam, Krishna, Kurnool, Cuddapah and Nellore districts. Some deposits are also located in the state of Tamil Nadu, Maharashtra and Rajasthan.

India contributes about 7 to 8 percent of the total world trade. Now deposits are being worked out specially for export purpose. For example, Bailadila and Rajhara mines of Chhatisgarh and Kiruburu mines in Orissa are being worked for this purpose. Japan, Romania, the former Czekoslovakia and Poland are important importing countries. Iron ore is exported from Haldia, Paradip, Marmagao, Mangalore and Visakhapatnam ports.

- India posseses over 20 percent of the world's total reserves in iron.
- Iron ore deposits are found practically in every state. However, 96 percent of the total reserves are in Orissa, Jharkhand, Chhatisgarh, Karnataka and Goa.
- Bailadila and Rajhara mines in Chhatisgarh and Kiruburu mines in Orissa are being worked out specially for export purpose.

(ii) Manganese Ore

India ranks third in the production of manganese ore in the world, next only to Russia and South Africa. About one fourth of the total production of India exported.

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

Distribution

The important areas of production are in Orissa, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh. Over 78 percent of total reserves of manganese ore of India occur in a belt stretching from Nagpur and Bhandara districts of Maharashtra to Balaghat and Chindwara district of Madhya

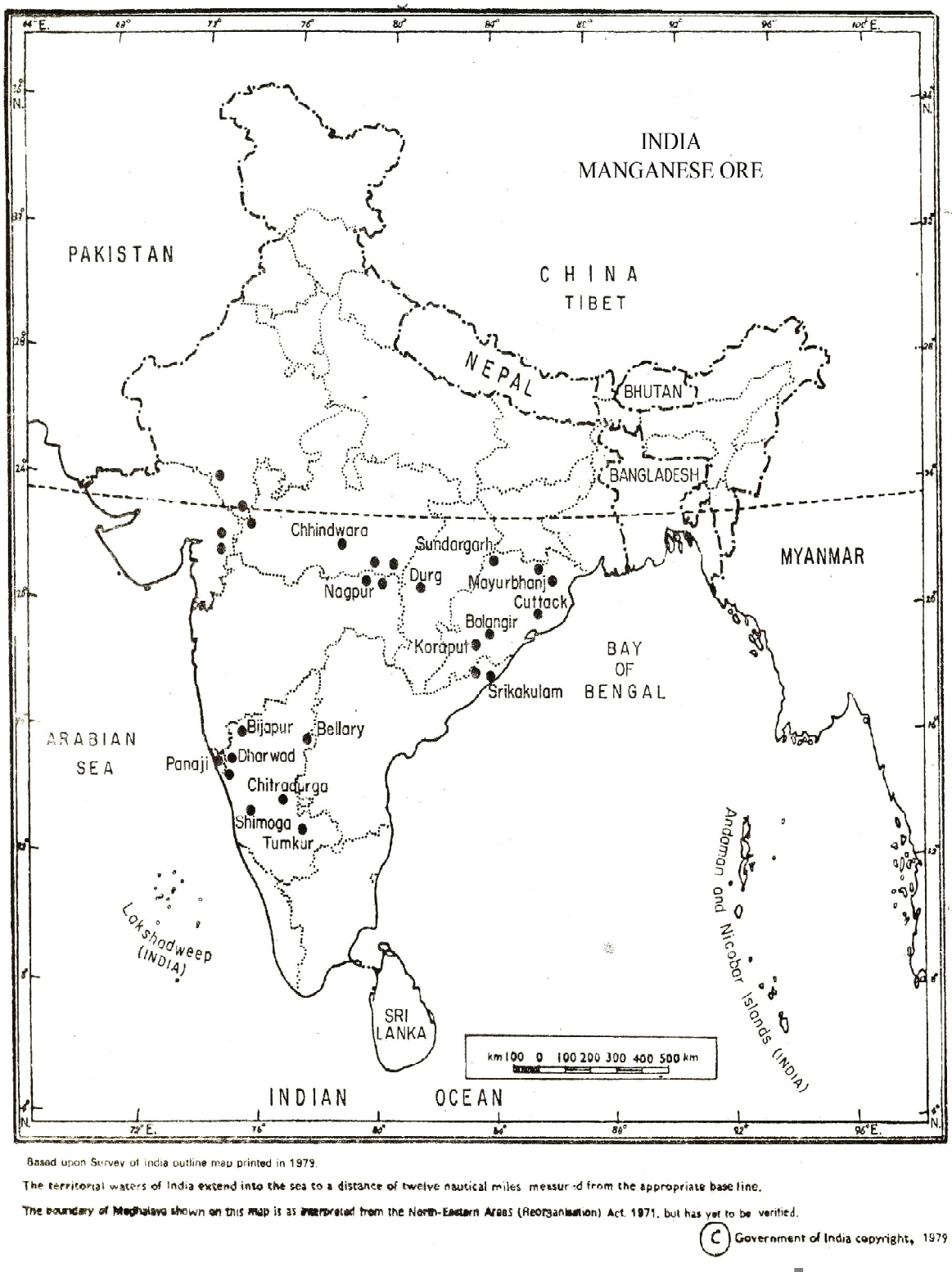


Fig. 23.5 INDIA : Distribution of Manganese ore

Pradesh. But these two states contribute only 12 and 14 percent of total production respectively. The remaining 22 percent of reserves are distributed in Orissa, Karnataka, Gujarat, Rajasthan, Goa and Andhra Pradesh.

Orissa tops in the production of manganese accounting for 37% of the total production of the country. Its reserves are only 12 percent of total reserves of India. The important mining districts are Sundargarh, Rayagada, Bolangir, Keonjhar, Jajpur, and Mayurbhanj.

In Karnataka, the deposits are located in the districts of Shimoga, Chitrdurga, Tumkur and Bellary. Small deposits are reported in Bijapur, Chikmagalur and Dharwar districts. Karnataka is the second largest producer of manganese ore, accounting for 26 percent of country's total productions. It accounts for 6.41 percent of country's total reserves.

Andhra Pradesh is a significant producer of manganese ore, contributing about 8 percent of India's total production, although her reserves are insignificant. Goa, Jharkhand and Gujarat also have some deposits of manganese ore.

- India ranks third in the production of manganese ore in the world.
- About 85 percent of total manganese consumption in India is used by metallurgical industries.
- The important areas of production are in Orissa, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh.

(b) NON-FERROUS METALLIC MINERALS

Non ferrous minerals are those which do not contain iron. They include gold, silver, copper, tin, lead and zinc. These metallic minerals are highly important in day to day life. However, India is very poor and deficient in all of these minerals

(i) Bauxite

Bauxite is a non-ferrous metallic mineral. It is the ore from which aluminium metal is produced. India's reserves of bauxite are sufficient to keep the country self-reliant. Aluminium extracted from the ore is used in making aeroplanes, electrical appliances and goods, household fittings, utensils etc. Bauxite is also used for manufacturing of white colour cement and certain chemicals. India's reserves of bauxite of all grades have been estimated at 3037 million tonnes.

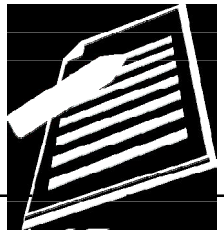


Table 23.4 Production of Bauxite in India

Year	Production (in thousand tonnes)
1951	68.1
1961	475.9
1971	1,517.1
1981	1,954.6
1991	4,977.0
2004-2005	11598.0

Source: India 2006: A Reference Annual p.570

Distribution

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

Jharkhand accounts for 13 percent of India's total reserves and 37 percent of the country's total production. The important deposits are located in Palamau, Ranchi and Lohardaga districts.

Gujarat contributes 12 percent to the total production and equal percentage to the total reserves of the country. The deposits are found in the Bhavnagar, Junagadh and Amreli districts.

Madhya Pradesh and Chhatisgarh accounts for 22 percent of the total reserves of the country and 25 percent of the total production. The three important bauxite ore regions in these states are Sarguja, Raigarh and Bilaspur districts in the Amarkantak Plateau; Maikala range in Bilaspur, Durg (bothe these regions are in Chhatisgarh), Mandla, Shahdole and Balaghat districts; and Katni district in Madhya Pradesh.

Maharashtra accounts for a relatively small production of the country, 18 percent of the total, but possesses the second largest bauxite reserves consisting of 22 percent of the country's total reserves. Bauxite occurs in Kolhapur, Raigarh, Thana, Satara and Ratnagiri districts.

In Karnataka the reserves of bauxite occur in the north-western parts of Belgaum district. Huge deposits of bauxite have been discovered in the eastern ghats in Orissa and Andhra Pradesh, Salem, Nilgiri and Madurai district of Tamil Nadu, and Banda district of Uttar Pradesh also have workable deposits of bauxite.

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

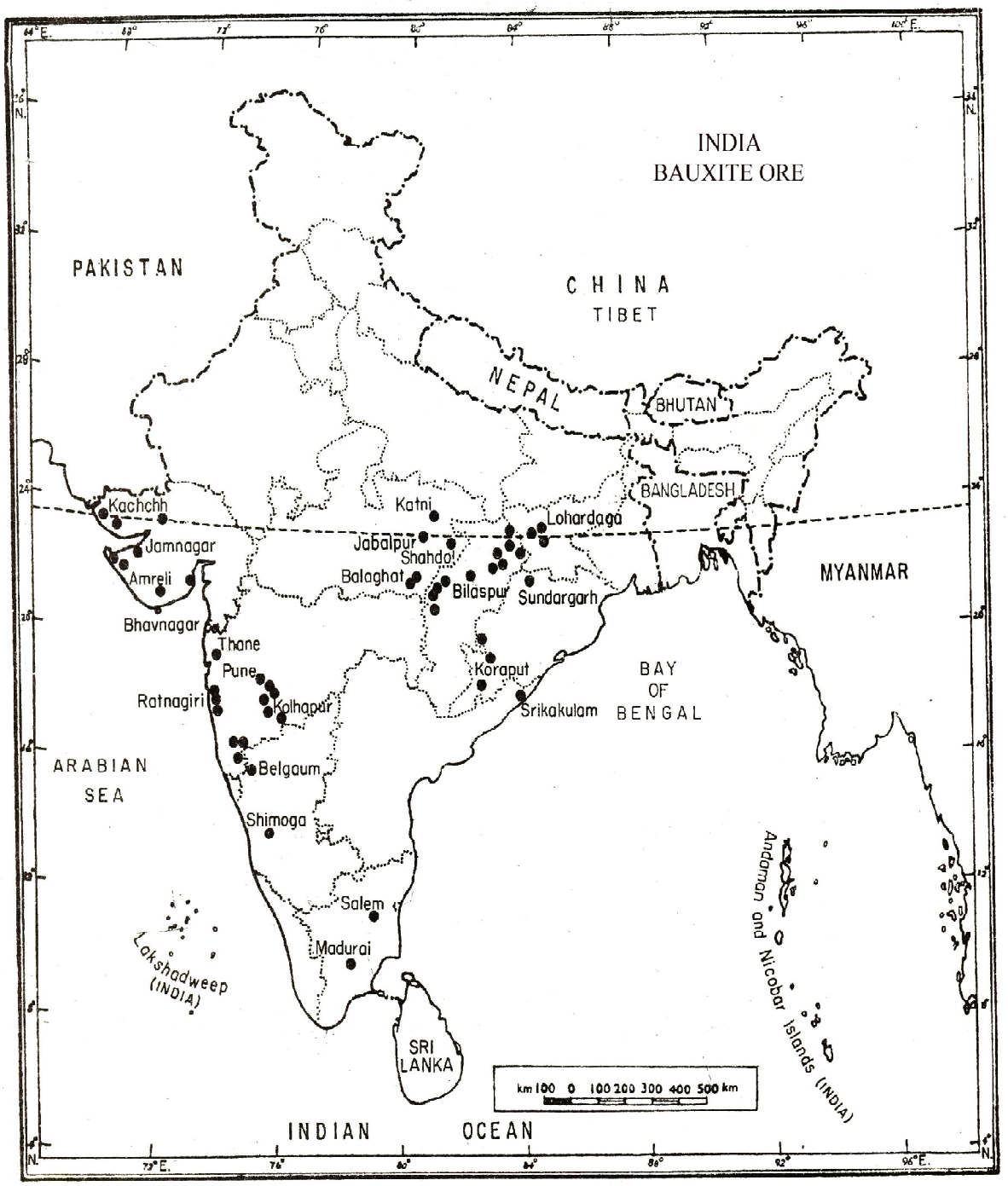
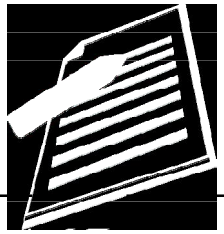


Fig. 23.6 INDIA : Distribution of Bauxite



- Bauxite is the ore from which aluminium metal is extracted.
- Bauxite is used for manufacturing white colour cement and certain chemicals.
- Major reserves occur in Jharkhand, Maharashtra, Madhya Pradesh, Chhatisgarh, Gujarat, Karnataka, Tamil Nadu, Goa and Uttar Pradesh.

(B) Non-metallic Minerals

A large number of non-metallic minerals are found in India but only a few of these are commercially important. They are limestone, dolomite, mica, kyanite, sillimanite, gypsum and phosphate. These minerals are used in a variety of industries such as cement, fertilizers, refractories and electrical goods. In this lesson we will be studying about mica and limestone.

(i) Mica

India is the leading producer in sheet mica. It was one of the indispensable minerals used in electrical and electronic industries till recently. However its synthetic substitute has reduced our exports as well as production considerably.

Distribution

Although mica is widely distributed but workable deposits occur in three principle belts. They are in the states of Andhra Pradesh, Jharkhand, Bihar and Rajasthan.

Bihar and Jharkhand produces the high-quality ruby mica. The mica belt in Bihar and Jharkhand extends from Gaya district in the west through Hazaribagh and Munger district to Bhagalpur district in the east. Outside this main belt, mica occurs in Dhanbad, Palamau, Ranchi and Singhbhum district. The state supplies more than 80% of the india's output. In Andhra Pradesh mica is found in a belt in Nellore district. Rajasthan is the third largest mica producing state. The mica, bearning zone, covers the districts of Jaipur, Udaipur, Bhilwara, Ajmer and Kishangarh. The quality of mica is inferior. Besides these three belts, some deposits occur in Kerala, Tamil Nadu and Madhya Pradesh.

Mica mining in India was mainly done for export. The principal importing country was the U.S.A. which took about 50 percent of the exports.

(ii) Limestone

Limestone is used in a wide range of industries. 76 percent of the country's total consumption is used in cement industry, 16 percent in iron and steel industry and 4 percent in chemical industries. The remaining 4 percent is

used by sugar, paper, fertilisers and ferromanganese industries. Limestone with high silica content is preferred in cement industry.

Distribution

Madhya Pradesh possesses 36 percent of the total reserves. Other major producing states are Chhatisgarh, Andhra Pradesh, Gujarat, Rajasthan, Karnataka, Tamil Nadu, Maharashtra, Himachal Pradesh, Orissa, Bihar, Jharkhand, Uttarakhand and Uttar Pradesh. The remaining part comes from Assam, Haryana, Jammu & Kashmir, Kerala, and Meghalaya. Karnataka contributes about 10 percent of the total reserves. They are found in Bijapur, Belgaum and Shimoga districts. In Andhra Pradesh the deposits are found in Visakhapatnam, Guntur, Krishna, Karimnagar and Adilabad districts. Sundargarh district of Orissa; Rohtas district of Bihar and Palamau districts of Jharkhand also have limestone deposits.

- India is the leading producers in mica.
- Mica is used in electrical and electronic industries.
- Mica is widely distributed but workable deposits occur in the states of Bihar, Andhra Pradesh and Rajasthan.
- Limestone is mostly used in cement, iron and steel, and chemical industries.
- Limestone is mostly found in Madhya Pradesh, Karnataka, Andhra Pradesh, Orissa, Bihar, Jharkhand and Meghalaya.

INTEXT QUESTIONS 23.2

1. Tick (√) the correct alternative from the choices given for each statement.

(a) Iron ore from Bailadila is exported through

(i) Paradip (ii) Kakinada

(iii) Visakhapatnam (iv) Haldia

(b) Iron ore with highest iron content is

(i) Magnetite (ii) Haematite

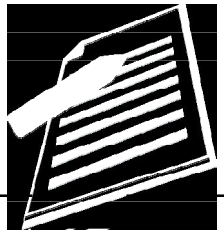
(iii) Limonite (iv) Saderite

(c) Which is the leading state in the production of Manganese ?

(i) Bihar (ii) Orissa

(iii) Madhya Pradesh (iv) Karnataka

(d) Which one of the following industry is leading consumer of manganese in India?



(i) Leather industries (ii) Match industries

(iii) Metallurgical (iv) Photography industries

(e) Bauxite is a

(i) Metallic mineral of ferrous group

(ii) Metallic mineral of non-ferrous group

(iii) Non-metallic mineral

(iv) Mineral fuel

(f) The ore of aluminium is

(i) Hematie (ii) Magnetite

(iii) Bauxite (iv) Limonite

(g) India is the leading producer of

(i) Lime stone (ii) Copper

(iii) Mica (iv) Phosphate

23.5 PROBLEMS

There are various problems posed by mineral extraction. The major problems are as follows:

(a) Depletion of Mineral

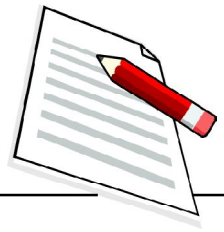
Due to the excessive exploitation, many minerals are going to be depleted in near future. So it calls for conservation and judicious utilisation.

(b) Ecological Problems

Mineral extraction has led to serious environmental problems. Rapidly growing mining activity has rendered large agricultural tracts almost useless. Natural vegetation has been removed from vast tracts. Such areas suffer from frequent floods and for want of proper drainage, they have become breeding grounds for mosquitoes spreading malaria with vengenance. In hilly mining areas landslide are a common phenomenon taking toll of life, cattle and property. In many mines, miners have to work under most hazardous conditions. Hundreds of lives are lost each year by fire in coal mines and due to occasional flooding etc. Occurrence of poisonous gas in pockets of mines is a great enemy of miners.

(c) Pollution

Many mineral producing areas lead to air and water pollution in the surrounding region which in turn lead to various health hazards.



Notes

(d) Social Problems

New discoveries of minerals often lead to displacement of people. As many tribal areas are rich in minerals, the tribal people are most affected. Industrialisation of such areas has badly shattered their economy, values and life style.

23.6 CONSERVATION OF RESOURCES

In world of diminishing resources, it becomes essential that the mineral resources should be judiciously used by the present generation to ensure a resource base for future generations. The strategies for resource conservation include:

1. Reclamation

Efforts should be made to reclaim various minerals as much as possible. This can be done by using latest technology. Remote sensing satellite has rendered a great help in identifying mineral resources.

2. Recycling

It means reuse of waste in a production process e.g. (a) The waste papers, rags, used bottles, tins, plastic waste material can all be recycled to produce paper, newsprint, plastics glass wares, packing tin materials etc. This process saves consumption of water and electricity considerably. Such steps can help to prolong the life of our depleted forest wealth. (b) Post consumption recyling - scrap iron from old machinery, automobiles, industrial equipment which is added to the charge and becomes cast iron or steel which is then shaped into a new consumer product.

3. Substitution

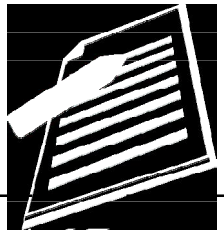
Due to advancement of technology and new needs have lead to many changes in the use of minerals. Products of petro-chemical industry have replaced traditional brass or clay jars. Plastics now compete with copper for uses such as piping and with steel in car bodies.

4. More efficient use

It also helps in conserning mineral resources for long. Today mineral resources are used more efficiently. For example engineering and construction processes which make automobiles more energy efficient and aerodynamic

23.7 ENERGY RESOURCES

This is an essential input for economic development and improving the quality of life. It is very difficult to imagine modern living without the use of energy resources. Day by day the consumption of energy has been increasing. It is available in various forms in India. In the following section we will discuss. it in details.



23.8 SOURCES OF ENERGY AND THEIR CLASSIFICATION

There are several sources of energy. They are classified in different ways. One way is to distinguish between commercial and non-commercial sources of energy. In rural India even today a large number of people use human labour or man power, animal power, animal refuge, farm or crop residue as easily available and relatively inexpensive sources of energy. As against this, the sources of energy used in urban areas are commercial in nature. They may include coal, petroleum, natural gas, cooking gas and electricity. But the scenario in rural areas has been changing for quite sometime.

Another classification of sources of energy is based on their longevity. For instance mineral resources such as coal, petroleum, natural gas and radio-active minerals are all non-renewable or exhaustible resources. On the other hand running water, the sun, wind, tides, hot springs and bio-mass are all inexhaustible or renewable sources of energy. They are also pollution free.

Mineral sources of energy include coal, petroleum and natural gas. These mineral sources of energy represent nothing but the stored energy of the sun. Hence they are also called fossil fuels. Then there are radio-active or atomic minerals. They all cause pollution. Non-mineral sources of energy include running water, sun, wind, tides and hot springs. The power derived from these is pollution free.

Yet another classification of energy is based on conventional and non-conventional sources. The former includes coal, petroleum, natural gas and running water. The non-conventional sources of energy include sun, wind, tides, hot springs and bio-mass.

- Fuel wood, animal waste and crop residue are traditional or non-commercial sources of energy. They still meet the energy demand in rural areas to a considerable extent.
- Coal, petroleum, natural gas, water falling from a hieght and uranium and thorium are the conventional sources of energy.
- The Sun, wind, bio-mass, tides and hot springs are the non-conventional sources of energy. They are still in the initial stage of experimentation for want of appropriate and viable technology.
- They are important because they are renewable and pollution free sources of energy.

23.9 GROWING PRODUCTION AND CONSUMPTION OF ELECTRICITY

Electricity is the most convenient and versatile form of energy. When, coal, petroleum and natural gas are used for generating electricity, it is called thermal energy. Power generated from running water, is known as water

power or hydel power or hydro-electricity. Yet another way of generating electricity is through nuclear fission from atomic minerals. This energy is termed as nuclear power. It is also a thermal energy but from a different source and needs highly developed technology.

In 1947 the per capita availability of electrical energy in India was as low as 2.4 KWH. By 1995-96 the per capita consumption of domestic power was 53 KWH. Despite vast improvement, this is very low compared to many other countries of the world. India is a country of about 600,000 villages. In 1947, hardly 300 villages had electricity. Now it has reached to more than 5 lakh villages. This became possible because we have increased production of electricity by about 85 times between 1947 to 2005. The installed power generation capacity in the country has increased from 1,400 MW in 1947 to 1,18,419.09 MW as on 31 March, 2005. This comprises of 80,902.45 MW thermal, 30,935.63 MW hydro 38,11.01 MW wind and 2770 MW nuclear.

Now let us have a look at the actual generation of electricity over these five decades. The total energy produced in 1950-51 was 6.6 billion kwh. By 1995-96 this figure rose to 415 billion kwh. Out of this over-all figure, the break up for 380 billion kwh is available as the remaining amount of 35 billion kwh stands under the head of non-utilities. The production of hydroelectricity in 1950-51 was 2.5 billion kwh. It rose to 72.5 billion kwh in 45 years i.e. by 1995-96. The production of thermal power was not much different from that of hydel power in 1950-51, when it was 2.6 billion kwh. This is more than four times the share of hydroelectricity. The share of nuclear energy is almost insignificant in the overall production of electricity.

INTEXT QUESTIONS 23.3

I. Answer the following questions:

1. (a) Name the two popular types of power plants in India.

   (i)_____ (ii)_____

   (b) Name a conventional source of energy which is renewable

   _____

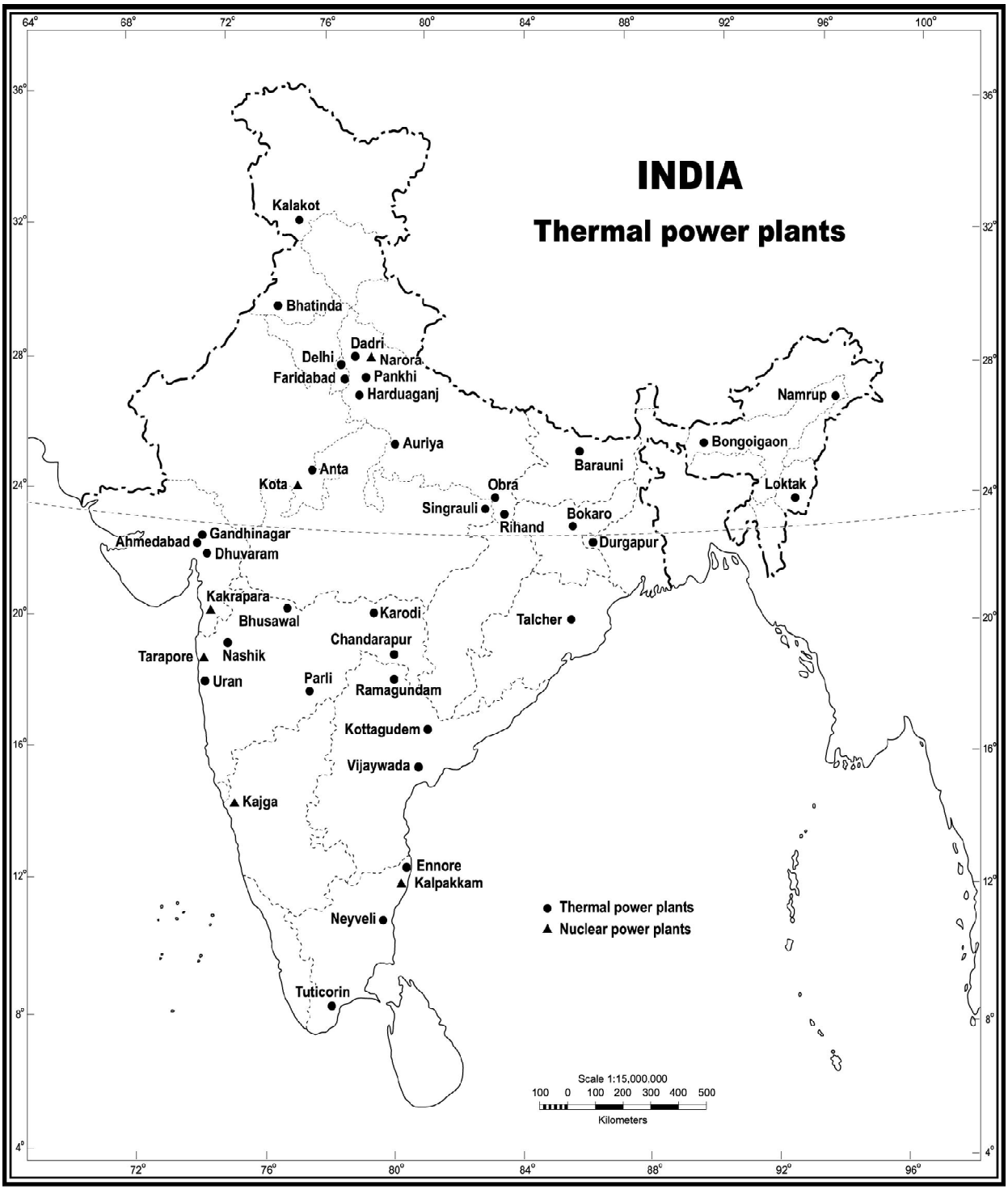
   (c) Name three minerals widely used for producing power in India.

   (i)_____(ii) _____ (iii)_____

II Choose the correct option

(1) Which one of the following sectors has shown sharp increase in power consumption in recent years?

   (a) Agriculture



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extened into the sea to a distance of twelve nautical miles measured from the aporopriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 23.7 INDIA : Thermal Power Plants

(b) Industry

(c) Transport

(d) None of them

(2) Which one of the following forms of energy is non-conventional?

(a) Thermal energy

(b) Hydel power

(c) Solar energy

(d) Nuclear power

(3) Which one of the following has the highest share in the total energy production?

(a) Hydel power

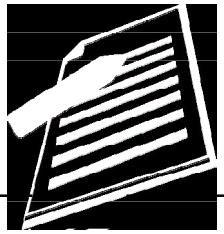
(b) Thermal power

(c) Nuclear power

(d) Wind energy

23.10 THERMAL POWER SOURCES

In thermal power, the major source of energy are coal, diesel and natural gas that are used for generation of electricity. It is the largest source of power supply in the country. The installed capacity of thermal power stations is about three times the installed capacity of the hydel power. During 2004-05 share of thermal power was about 80,903MW out of 1,18,419MW of electricity produced in the country. This is approximately 68% of the total electricity produced in India. Share of thermal electricity increased very rapidly after creation of the National Thermal Power Corporation (NTPC) in



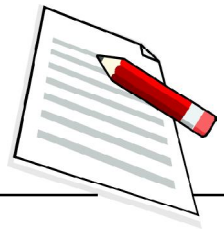
the year 1975. Presently, NTPC has to it's credit 13 coal based super thermal power projects and seven gas/liquid fuel based. During the 2004-05, NTPC produced 24,435 MW which is about 30% of the all India thermal production during the same period. Coal based thermal power units-have been set up near the coal mines to avoid transport costs. Transmission of power over long distances is relatively cheaper despite some loss of energy in transit.

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

Besides coal based thermal power plants, the latest trend is to encourage diesel and natural gas based thermal power plants. Such plants can be set near the distribution or market centres. The gestation period of oil or gas based plants is generally the shortest. These plants are also found to be more efficient than coal based plants. The oil and gas pipes have to be laid for continious supply of petroleum and natural gas for such power plants.

As India is poor in its mineral oil and proven gas resources, it has to import these raw materials including naptha etc. from Middle East countries. The new Dabhol Thermal Power plant of Maharashtra on the Konkan coast is based on such imported raw material. This plant is an indicator of the new trend.

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



Notes

It is very interesting to note that Karnataka and Kerala states in South have not a single thermal power plant till now. Can you explain the reason?

23.11 HYDEL POWER RESOURCES

Water power resource differs from thermal power in more than one ways. It is a renewable or inexhaustible resource. It is pollution-free. Its recurring or maintenance coast is minimal. However, this source of energy, has two major drawbacks. Firstly, it calls for huge financial lay out particularly in those regions where water is to be impounded in huge quantity to ensure free flow of water all the year round. Secondly, in most cases its gestation period is too long.

With the water power potential of 41000mw, India ranks fifth in world after congo, Russia, Canada and the U.S.A.

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

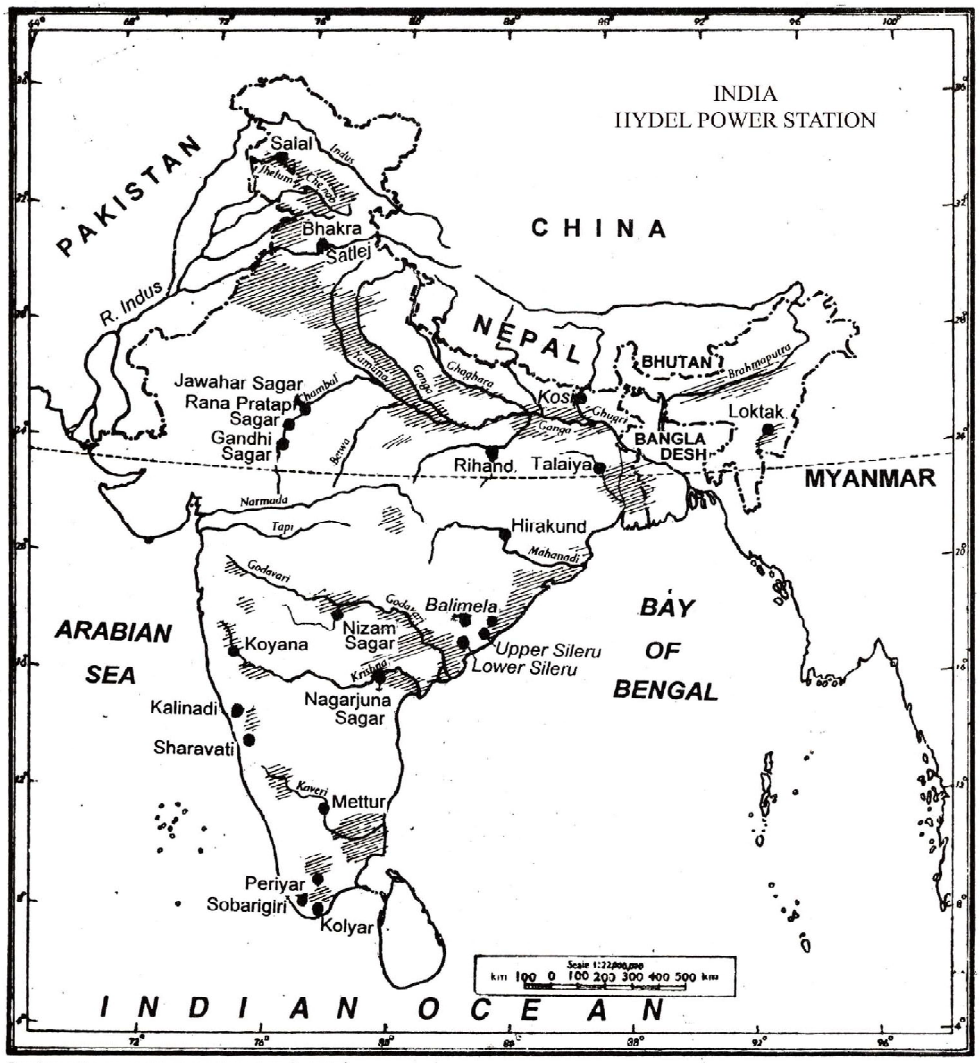
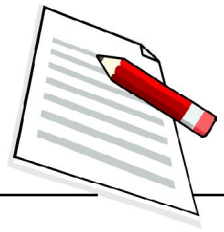


Fig. 23.8 INDIA: Hydel power station

Total installed capacity of hydroelectricity increased to 25219.55 MW at the end of 2000-01, which was nearly one-fourth of the total installed capacity, of electricity. In spite of being cheaper, pollution-free and renewable source of power, significance of hydroelectricity has declined in post-independence period. Its share in total power generation declined from 49 percent in 1950-51 to only 14.9 percent in 2000-01. Nevertheless, hydroelectricity plays a very significant role in northern, western and southern grids. The Northeastern grid is primarily dependent on hydel power.

In context of the energy crisis in the country hydroelectric power has assumed pivotal significance. Indian rivers drain 1677 billion cubic metres of water to the sea every year. The Central Water and Power Commission estimated the potential of hydroelectric power at about 40 million kW at 60% load factor from these rivers. Central Electricity Authority re-estimated



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this potential at 84,000 MW at 60% load factor. It is equivalent to about 450 billion units of annual energy generation. Basin-wise distribution of the potential is given in Table.

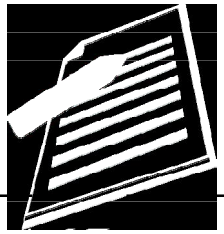
Table 23.5: India: Basin-wise estimated Potential of Hydropower (potential in thousand MW at 60 per cent load factor)

Basin	Potential	% of Total
Indus	20.0	23.8
Brahmaputra	35.0	41.7
Ganga	11.0	13.1
Central Indian basins	3.0	3.6
West flowing rivers	6.0	7.1
East flowing rivers	9.0	10.7
Total	**84.0**	**100.0**

This potential depends on several physical and economic factors. Among them, river regime, volume of river water, regularity in river flow (all these are dependent on rainfall pattern), nature of terrain, availability of other sources of power, level of economic development creating demand, and technological status are important. Regular flow of sufficient water with high velocity provides favourable condition for the development of hydroelectricity. Amount and regularity of flow depends on nature of rainfall while slope determines the velocity of flow. Since these conditions vary throughout the country, the distribution of hydropower potential is also very uneven.

The rivers originating from the northern mountainous region are the most important ones in this respect. They have their sources in glaciers and snowfields, therefore, they are perennial and their flow of water is regular throughout the year. Velocity of flow is high because of dissected terrain and the competition for use of water for other purposes is low. The northeastern part of this mountainous region, constituting the Brahmaputra basin, has the largest power generating potential. The Indus basin in the northwest is at second place. The Himalayan tributaries of the Ganga have a potential of 11,000 MW. Thus, three-fourths of the total potential is confined in the river basins originating from the northern mountainous region.

The rivers of peninsular India are comparatively poor in this respect. They depend entirely on the rainfall for their flow, and therefore, their flow is very erratic exceptionally high flow during the monsoon period fol1owed by a long period of lean flow. Storage of water is essential to regulate the flow. The bulk of the potential in this part is confined in the hilly regions along the



middle and upper reaches of various river systems. The topographical features in these reaches are seldom favourable for development of irrigation. Consequently, development of hydroelectric sites would not clash with other priority uses of water. The Western Ghats, Northwestern Karnataka, Nilgiri and Anamalai hills and upper Narmada basin are major areas of concentration of potential in peninsular India. Despite this, potential of hydropower has been comparatively more developed in southern states because these states are far away from coalfields of the northeastern plateaus.

Table 23.6 Important Hydroelectric Plants in Different States of India

States	Name of Hydroelectric Plants
Jammu and Kashmir	Lower Jhelum, Salal on Chenab, Dool Hasti and Karrah.
Punjab and Himachal Pradesh	Bhakra-Nangal on Satluj, Dehar on Beas, Giri Bata, Andhra, Binwa, Rukti, Rongtong, Bhabanagar, Bassi, Baira Siul, Chamera, Nathpa-Jhakri on Satluj (biggest hydel power project in India).
Uttar Pradesh	Rihand, Khodri, Chibro on Tons.
Uttarakhand	Tehri dam on Bhagirthi.
Rajasthan	Ranapratap Sagar and Jawahar Sagar on Chambal.
Madhya Pradesh	Gandhi Sagar on Chambal, Pench, Bargi on Narmada, Bansagar-Tons.
Bihar	Kosi.
Jharkhand	Subarnarekha, Maithon, Panchet, Tilaiya (all three under DVC).
West Bengal	Panchet.
Orissa	Hirakund on Mahanadi, Balimela.
Northeastern states	Dikhu, Doyang (both in Nagaland), Gomuti (Tripura), Loktak (Manipur), Kopili (Assam), Khandong and Kyrdemkulai (Meghalaya), Serlui and Barabi (Mizoram), Ranganadi (Arunachal Pradesh).
Gujarat	Ukai (Tapi). Kadana(Mahi).
Maharashtra	Koyana, Bhivpuri (Tata Hydroelectric Works), Khopoli, Bhola, Bhira, Purna, Vaiterna, Paithon, Bhatnagar Beed.
Andhra Pradesh	Lower Sileru, Upper Sileru, Machkund, Nizam Sagar, Nagarjun Sagar, Srisailam (Krishna).

Karnataka	Tungabhadra, Saravati, Kalinadi, Mahatma Gandhi (Jog fall), Bhadra, Sivasamudram (Kaveri), Shimsapura, Munirabad, Lingnamakki.
Kerala	Iddikki (Periyar),Sabarigiri,Kuttiaddy, Sholayar, Sengulam, Pallivasal, Kallada, Neriamangalam, Parambikulam Aliyar, Poringal, Ponniar.
Tamil Nadu	Pykara, Mettur, Kodayar, Sholayar, Aliayar, Sakarpathi, Moyar, Suruliyar, Papanasam.

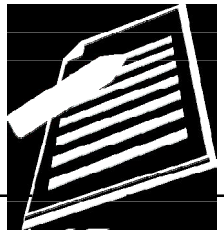
23.12 NUCLEAR POWER

India had developed the technology of generating energy from nuclear minerals such as uranium and thorium. Installation of nuclear rectors for generating power requires huge capital and sophasticated technological skills. The share of nuclear power, in the total energy produced in the country is hardly2%. Nuclear power is a promising source of energy for future. It would play a complementary role when the other sources of power like coal and petroleum would be exhausted.

Nuclear power programme was initiated in the 5th decade of the last century and an apex body for decision-making regarding atomic programmes, the 'Tata Atomic Energy Commission' was incorporated in August 1948. But progress in this direction could be made only after the establishment of the Atomic Energy Institute at Trombay in 1954. Which was renamed as the 'Bhabha Atomic Research Centre' (BARC) in 1967. Consequently, first nuclear power station with 320 MW capacity was set up at Tarapur near Mumbai in 1969. Later, atomic reactors were installed at Rawatbhata (300MW) near Kota in Rajasthan, Kalpakkam (440 MW) in Tamil Nadu, and Narora in Uttar Pradesh, Kaiga in Karnataka and Kakarapara in Gujarat also have nuclear energy plants. Thus at present, nuclear energy is produced from ten units located at six centres. Requirements of fuel and heavy water of these power reactors are fulfilled by the Nuclear Fuel Complex located at Hyderabad and heavy water plant at Vadodara.

16,707 mus nuclear power was generated in the year 2004-05 which is a small fraction of the country's total production of electrical energy. The Department of Atomic Energy (DAE) has an ambitious nuclear power programme aiming at achieving an installed nuclear power capacity of 20,000 Mwe by the year 2020.

Generation of nuclear power is highly hazardous. A slight carelessness in the security may cause severe accidents endangering lives of thousands of people in its surrounding areas. Therefore, strict precautions and security measures are highly essential.



23.13 REGIONAL CLASSIFICATION ON THE BASIS OF SOURCES OF ELECTRICITY

Three types of regions can be identified on the basis of sources of electricity:

1. **Hydro-electricity dominated region:** The states included under this category are Karnataka, Kerala, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Meghalaya, Nagaland, Tripura, and sikkim. These states are far away from coal fields but have optimum conditions for the development of hydro electricity.

2. **Thermal power dominated region:** It included states such as West Bengal, Jharkhand, Bihar, Chhatisgarh, Madhya Pradesh, Gujarat, Uttar Pradesh, Maharashtra, Assam, Delhi, Haryana and Punjab. Majority of these states have reserves of coal which are utilised for power generation. Bihar, Uttar Pradesh, Haryana and Punjab do not have coal reserves but have direct acces to coal fields by railway lines. However, they are diversifying their sources of power.

3. **Nuclear power dominated region:** Rajasthan is the only state which comes under this category. In Rajasthan more than half of the total commercial energy is nuclear. It's because the state is deficit both in coal and water.

INTEXT QUESTIONS 23.4

I Fill in the blanks:

(i) Electricity generated by using coal is _____ energy.
(hydel energy, thermal energy)

(ii) The electricity generated by the force of running water is _____energy. (Hydel energy, Tidal energy)

(iii) The two minerals used for generating nuclear power are (1)_____ and (2) _____ (Uranium, Coal, Thorium)

(iv) The first atmotic power station developed in India was at _____ (Rawat Bhata, Tarapur)

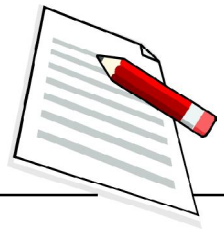
II Answer the following Questions briefly:

(i) Give two main advantages of Hydel power.

(a)_____ (b)_____

(ii) What rank does India hold in the world in water power potential?

_____



Notes

(iii) Name two gas based thermal power plants in UP.

(a)_____ (b)_____

(iv) Which region of India has developed the largest proportion of its water power potential?

_____

23.14 NON-CONVENTIONAL SOURCES OF ENERGY

Conventional sources of power like coal, petroleum and natural gas are likely to exhaust in near future. The development of hydel power alone can not meet the demand of electricity for the future. Therefore, there is a need to find and develop alternative sources of power. Sun, wind, tides, biologoical wastes and hot springs are such sources which can be developed as the alternative sources of power. They are called the non-conventional sources of energy. These sources of energy are renewable and pollution free. We shall discuss some important non-conventional sources of energy with reference to their development in our country.

(a) Solar energy

For the planet earth, the Sun is the primary source of all energy. Sun is the most vital, abundant and direct source of energy. India lies in the tropical zone and has plenty of sun shine, for long hours of a day. There are large possibilities to develop solar energy in the country and that too without much cost.

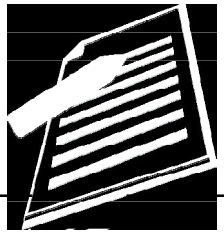
Solar energy is tapped through the system of Solar Photo Voltaic (SPV) cells. The thermal heating system can be used for water heating, solar codkers for cooking meals and drying food grains etc. Solar energy can be developed in almost every part of the country but more so in hot, dry and cloud free areas like Rajasthan.

(b) Wind Energy

Wind can be used as a source of energy in those regions where strong and constant winds blow throughout the year. Wind energy can be used for pumping water for irrigation and also for generating electricity. India has about 45,000MW estimated wind power potential. Prospective sites for generating electricity wind have been located in Tamil Nadu, Gujarat, Andhra Pradesh, Karnataka and Kerala. The potential that can be tapped at present is limited to around 13,000 MW. But at present 2,483MW is generated through wind which places India in the fifth position globally after Germany, USA, Denmark and Spain.

(c) Biogas

Biogas is obtained by using animal refuge like cow dung. It is widely used in rural areas mainly as domestic fuel. Efforts are being made to popularise the biogas plants in the country.



Urban and industrial waste is another source of biological energy in big cities and industrial centres. These materials can be used for generating electricity or biogas. The work in this direction is still in its initial stage. Such plants have been installed in Delhi and few cities in India.

(d) Biomass Energy

Energy generated from farm or agricultural wastes, agro-industrial wastes, energy plantations etc is known as biomass energy. The potential of biomass power in the country has been estimated at about 19,500 MW. So far a total capacity of 614 MW biomass based power generating system has been installed and a capacity of 643MW are under installation in the country.

(e) Tidal Energy

Energy can also be generated from high tidal waves. Some of the important sites identified for generating tidal energy are located in the Gulf of Kuchch and Cambay in Gujarat state and the coast of Kerala. A plant of 150 MW capacity has been installed on Kerala coast.

(f) Geothermal energy

The potential of geotherma1 power is very limited in India. Important sites selected for generating geothermal power are situated in Himachal Pradesh (Mani Karan) and Jammu and Kashmir (Puga valley in Ladakh). Assessment of geothermal energy potentials of selected sites in Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Jharkhand and Chhatisgarh is being undertaken.

As we have discussed earlier, the non-conventional sources of energy are renewable and pollution free. They can be helpful in the utilization of resources scattered all over the country. But the development of these energy resources is very slow, due to lack of suitable and economically viable technologies. Even so there is no doubt that they would become a reality in not a very distant future.

There are prospects of expanding the manufacturing industries and mechanization of agriculture in the nooks and corners of the country. Naturally there will be more demand for energy derived from the non-conventional sources.

INTEXT QUESTIONS 23.5

Answer the following Questions briefly:

(i) Give two main advantages of non-conventional sources of power.

(a)_____ (b)_____

(ii) Which areas of the country have largely been benifitted by biogas plants?

_____

(iii) Name two sites identified for developing tidal energy in Gujarat

(a)_____ (b)_____

(iv) Name two ways of tapping the solar energy.

(a)_____ (b)_____

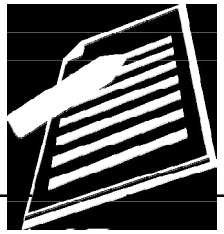
(v) Which are the two main uses of tapping wind energy?

(a)_____ (b)_____

WHAT YOU HAVE LEARNT

Mineral and power resources play an important role in the industrial development of a nation. They provide the industrial raw materials and fuel. Minerals are classified into metallic and non-metallic minerals. Metallic minerals can be further grouped into ferrous and non-ferrous. Mineral fuels are coal, petroleum, and natural gas. India's position is particularly good in the metallic minerals of ferrous group. It is well endowed with iron ore of high quality. India has rich deposits of mica and bauxite. It is also one of the leading producers of mica in the world. Coal is the primary source of power in India. It occurs in the rock formations of Gondwana and Tertiary age. Gondwana coal fields account for 96% of the total reserves and production in India. India's position is not satisfactory in the reserves as well as production of petroleum. Assam belt and Gujarat-Cambay and Bombay High belt are the two important petroleum producing regions in India. Uranium and thorium are the two important atomic minerals in India. The major problems faced by mineral resources are depletion of mineral resources, ecological problems, pollution and social problems. Various methods are adopted for conservation of mineral resources. The measures are reclamation, recycling, substitution and more efficient uses.

Recently some on-shore as well as off-shore oil fields has been discovered. On-shore oil fields are discovered in the state of Rajasthan where as off-shore oil fields are discovered along the coast of Tamil Nadu and Andhra Pradesh. Natural gas is energing as an important source of commercial energy because in recent years more and more reserves are discovered at eastern coast namely Krishna, Godavari and Mahanadi basins.



Energy is a highly important infrastructural resource for the economic development of a country. Main sources of power are coal, petroleum, natural gas, nuclear power and water power. All these sources are known as the conventional sources of energy. Power generated by the use of coal petroleum and natural gas is called thermal energy. These sources of energy are exahaustible and non-renewable. They cause pollution. Hydel power is a renewable and pollution free source of energy. Its maintenance costs are very low. Nuclear power is source of power. It requires huge capital and sofisticated technology. Careful handling and security measures are necessary for the protection of life all around their sites. The share of thermal power is more than 70 percent out of the total energy produced in India. Next comes is the hydel power whose share is about 26 percent. The share of nuclear power is only less than 2.5 percent.

Coal based thermal power plants are located either near the coal fields or near the consumption centres. These plants are largely located in Madhya Pradesh, Chhatishgarh, Jharkhand and Orissa. However, thermal plants on the borders of Uttar Pradesh, Maharashtra and Andhra Pradesh are also very important as they serve far off regions in these three states. There has been sufficient development of hydel power in the southern states. India has developed about 50 percent of its total water power potential. Sun, winds, tides, hot springs, biogas etc. are the alternative sources of power. They are known as non-conventional sources of energy. They are renewable, pollution free and inexpensive. There is a slow progress in the utilisation of these sources for want of suitable and economically viable technologies.

TERMINAL QUESTIONS

1. Describe the position of India in mineral resources.
2. Describe the distribution and production of the following minerals and mineral fuels in India:
   (a) Iron Ore
   (b) Coal
   (c) Petroleum
3. What are the problems associated with exploitation of mineral resources?
4. Describe various methods of conservation of mineral resources.

5. Answer in briefly:

   (i) Name three important sources of energy which are non-renewable and also pollution free.

   (ii) Differentiate between thermal, hydel and nuclear energy. State the share of each in the total production of energy.

   (iii) Mention two advantages of non-conventional sources of energy.

   (iv) Describe the role of biogas as an energy for the rural areas.

6. Distinguish between

   (i) Conventional and Non-conventional sources of power.

   (ii) Solar energy and Wind energy.

7. On an outline map of India show the following

   (i) Jharia and Raniganj coal fields.

   (ii) Ankaleswar and Digboi oil fields.

   (iii) Mathura and Panipat oil refineries.

   (iv) Talcher and Korba thermal power plants.

   (v) Kaiga and kota atomic power plants.

   (vi) Bhakra and Nagarjuna Sagar hydro-electric plants.

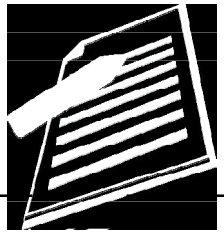
ANSWER TO INTEXT QUESTIONS

23.1

1. (a) coal (b) South-western plateau (c) Barauni (d) Assam and Gujarat (e) Damodar valley (f) Jammu and Kashmir (g) Jharia (h) Krishna and Godavari

23.2

1. (a) Visakhapatnam (b) Haematite (c) Orissa (d) Metallurgical industries (e) Metallic minerals of non-ferrous group (f) Bauxite (g) mica



23.3

I (a) (i) Thermal (ii) hydel (b) hydel power (c) (i) coal (ii) petroleum and (iii) natural gas.

II 1. (a), 2. (c), 3. (b)

23.4

I (1) Thermal energy (2) hydel energy (3) Uranium and Thorium (4) Tarapur.

II.

(i) (a) renewable and (b) pollution free

(ii) fifth

(iii). (a) Dadri (b) Auriya

(iv) Peninsular region

23.5 (i) (a) pollution free (b) renewable

(ii) Rural areas

(iii) (a) Gulf of Kachch and (b) Gulf of cambay

(iv) (a) Thermal heating system and (b) generating electricity through photovoltaic routes.

(v) (a) For pumping water and (b) for generating electricity

HINTS TO TERMINAL QUESTIONS

1. Refer to section 23.1

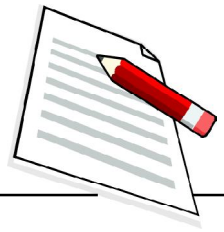
2. (a) Refer to (i) Iron ore under (a) Ferrous metallic minerals of section 23.4(A)

   (b) Refer to section 23.3(a)

   (c) Refer to section 23.3(b)

3. Refer to section 23.5

4. Refer to section 23.6



Notes

5. (i) Refer to section 23.8

   (ii) Refer to sections 23.10, 23.11 and 23.12

   (iii) Refer to section 23.14

   (iv) Refer to section 23.14(c)

6. (i) Refer to sections 23.8, 23.10, 23.11, 23.12 and 23.14

   (ii) Refer to section 23.14(a) and (b)

7. Refer to maps.