Chapter 7

Resources

NATURAL RESOURCES

Any matter or energy derived from the environment (nature) that is used by living things including humans is called a natural resource. Resources are the basis for the development of any country. India, one of the largest countries in the world, is blessed with diverse and abundant resources. Only a judicious use of resources will help the development of a country. Over exploitation and unscientific land-use practices will lead to environmental problems and to resource depletion. Natural resources include air, water, soil, minerals, fossil fuels, plants and wild life. Many of these natural resources are essential for human survival; e.g. air, water, and plants. Others are used for satisfying other material needs and desires.

Natural resources have been classified in many ways. One way is to classify them on the basis of the source of their origin. Accordingly, there are land, soil, water, plant, animal, mineral, and energy resources.

Another method of classification is according to the stage of development of a resource. Those resources which are found in the region, but have not been put to proper use are called **Potential resources**. For example, the state of Assam and the Brahmaputra River have a vast potential of water resources, but all of them have not yet been determined and utilized, fully. The resources which have been surveyed and quantified for actual use are called **Actual resources**. The development of the actual resource depends on the technology available and the cost involved. That portion of the actual resource which can be developed profitably with available technology is termed a **Reserve resource**. For example, an increase in the world price of metal such as iron makes it profitable to utilise even low grade ore, thus turning a resource into a reserve. Natural resources may also be classified as **renewable** and **non-renewable** resources. The main characteristics of these resources are given below:

Renewable Resources: Resources which get renewed or replenished fast, are called renewable resources. Some of these resources are always available (continuous) and do not get affected by human activities; e.g., solar and wind energy. Many resources, on the other hand, get depleted after use. These may, however, be replenished without endangering future use, provided that the

rate of consumption does not exceed the rate of renewal or replenishment. Hence, they maintain a flow. Some resources like crops take short time for renewal. Others like water can be renewed in a comparatively longer time. Some other resources like forests take even longer.

Non-renewable Resources: Non-renewable resources are built over a long geological time span. Minerals and fossil fuels are the examples of non-renewable resources. Since the rate of their formation is extremely slow, they can not be replenished within a time frame meaningful to human-beings. Though these resources are normally found in large quantities, they are distributed most unevenly. Their economic use is viable only when they are found in sufficiently large concentrations and are extractable. Some of these resources like gold, silver and iron are recyclable in nature. It means that the metal content obtained from the ore may be used again and again after necessary processing. Fossil fuels such as coal, mineral oil and natural gas get exhausted. Hence, they are non-recyclable.

MINERAL RESOURCES

A mineral is an aggregate of two or more than two elements. A mineral has a definite chemical composition, atomic structure and is formed by inorganic processes. In economic geography, the term mineral is used for any naturally occurring material that is mined and is of economic value.

Minerals generally occur in the earth's crust in the form of ore. It is extracted, processed and utilised for the economic benefits of society. The availability and per capita consumption of minerals is taken as an important indicator to assess the economic development of a country.

India is fairly rich in mineral resources but their distribution is highly uneven. The distribution of minerals in India has been described in the following section:

Distribution of Minerals

The mineral wealth of India is largely confined to the igneous and metamorphic rocks of Peninsular India, while the Great Plains of India and the Himalayan region are almost devoid of the metallic minerals. The states which are rich in the metallic and non-metallic minerals are Jharkhand, Chhattisgarh, Odisha, Bihar, West Bengal, Madhya Pradesh, Karnataka, Maharashtra, Tamil Nadu, Gujarat, Uttarakhand, Andhra Pradesh, and Assam. The states of Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu and Kashmir, and Gangetic West Bengal are, however, poor in mineral resources.

Mineral Belts of India

The following mineral belts may be identified in India (**Fig. 7.1**):

1. The Chotanagpur Belt This belt stretches over, Jharkhand, Chhattisgarh, Odisha, Bihar and West Bengal. This region is rich in coal, mica, manganese, chromite, ilmenite, bauxite, iron, uranium phosphate, copper, dolomite, china-clay, and limestone. The important mineral producing districts are Dhanbad, Hazaribagh, Palamu, Ranchi, Santhal-Pargana, and Singhbhum in Jharkhand; Cuttack, Dhankenal, Kendujhar (Keonjhar), Koraput, Mayurbhanj, Sambhalpur, and Sundargarh in Odisha; and Bankura, Birbhum, Medinipur and Purulia in West Bengal. This region contains almost 100% of kyanite reserves, 93% of iron ore, 84% coal, and 70% of chromite of the country.

2. The Midland Belt This belt sprawls over the states of Chhattisgarh, Madhya Pradesh, Andhra Pradesh, and Maharashtra. This belt is rich in manganese ore, bauxite, mica, copper, graphite, limestone, lignite, marble, and limestone.

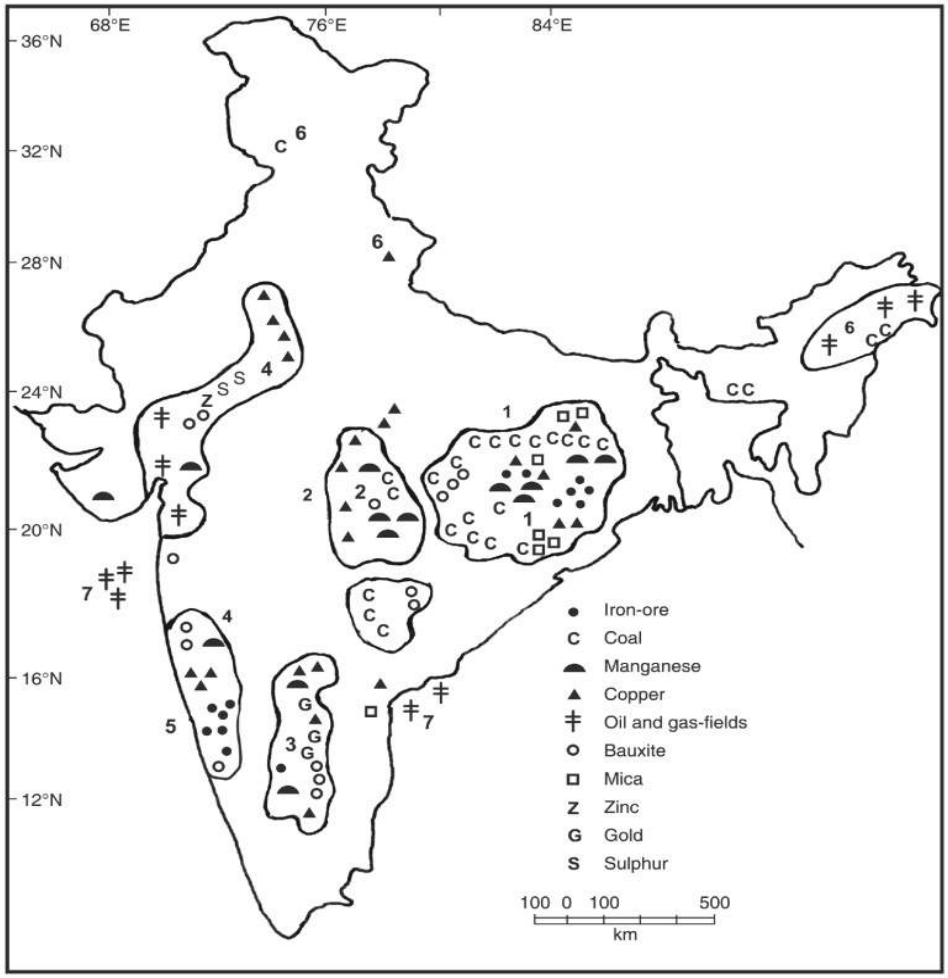

Fig. 7.1 Mineral Belts

3. The Southern Belt It stretches over the states of Andhra Pradesh, Karnataka and Tamil Nadu. This belt is rich in gold, iron ore, chromite, manganese, lignite, mica, bauxite, gypsum, asbestos, dolomite, ilmenite, china-clay, and limestone.

4. The Western Belt This belt stretches over the states of Rajasthan, Gujarat, and Maharashtra. The belt is rich in non-ferrous metals like copper, lead, zinc, uranium, mica, manganese, salt, asbestos, building stonnes, precious stonnes, mineral oil, and natural gas.

5. The South-Western Belt This belt sprawls over Goa, Karnataka, and Kerala. It contains the deposits of iron ore, ilmenite, zircon, monazite sands, garnet, china-clay, bauxite, mica, limestone, and soapstone.

6. The Himalayan Belt In general, the Himalayan belt is poor in metallic minerals. There are, however, valuable pockets of minerals, like copper, lead, zinc, bismuth, bauxite, antimony, nickel, cobalt, tungsten, precious stonnes, gold, silver, gypsum, limestone, and dolomite in the Himalayas.

7. The Indian Ocean The continental shelf of the Arabian Sea and the Bay of Bengal are rich in mineral oil and natural gas. The seabed also contains high grade nodules of manganese, phosphate, barium, aluminium, silicon, iron, titanium, sodium, potassium, chromium, monazite, ilmenite, magnetite, and garnet. The best quality of nodules are found at a depth of about 4000 metres.

Classification of Mineral Resources

The minerals may be classified under the following three categories:

1. Mineral Fuels (fossil fuels)
2. Metallic Minerals
3. Non-metallic Minerals

1. Mineral Fuels

This group includes energy resources like coal, mineral oil (petroleum), natural gas, and atomic minerals.

Energy Resources (For details see Chapter 8)

2. Metallic Minerals

Metallic minerals constitute the second most important group of minerals after fossil fuels. These minerals provide a strong base for the development of metallurgical industry, and thereby help the process of industrialisation and urbanisation. India has a substantial reserve of these minerals **(Fig. 7.2).**

Iron-Ore Iron ore is the most important mineral on which hinges the economy of a country. Iron ore is not found in pure form in the earth's crust, rather it is often found mixed with lime, magnesium, phosphorus, silica, sulphur, and copper.

Types of Iron Ores There are four main types of iron ores found in India. They are: (i) Haematite, (ii) Magnetite, (iii) Limonite, and (iv) Siderite.

(i) **Haematite ore** (red-ochre): This is called '*oxide of iron*'. Its metallic content varies between 60 to 70 per cent. It is a massive, hard, compact and lumpy ore with reddish or coral-red in colour. It is mainly found in the Dharwarian rocks. The main deposits of haematite ore are in Jharkhand (Iron-Series), Odisha (Mayurbhanj), Chhattisgarh (Bailadila Dalli-Rajhara), Madhya Pradesh, Karnataka (Kudermukh, Baba-Budan), Goa, Maharashtra, and Andhra Pradesh.

(ii) **Magnetite**: The magnetite ore is known as *'black ore'*. The metal content of magnetite varies between 60 to 65 per cent. The ore is either igneous of metamorphic. It is mainly found in the Dharwar and Cuddapah Systems of Karnataka (Dharwar, Shimoga Districts), Andhra Pradesh (Bellary District), Tamil Nadu (Salem, Tiruchirappalli districts), and Kerala states.

(iii) **Limonite:** It is yellowish in colour and is known as the *'hydrated iron-oxide'*. It is inferior and contains 35 to 50 per cent of metal. It is found in the iron-stone shales of the Damuda Series in Raniganj coal fields, Mirzapur District of Uttar Pradesh, Garhwal region of Uttarakhand, and the Kangra Valley of Himachal Pradesh.

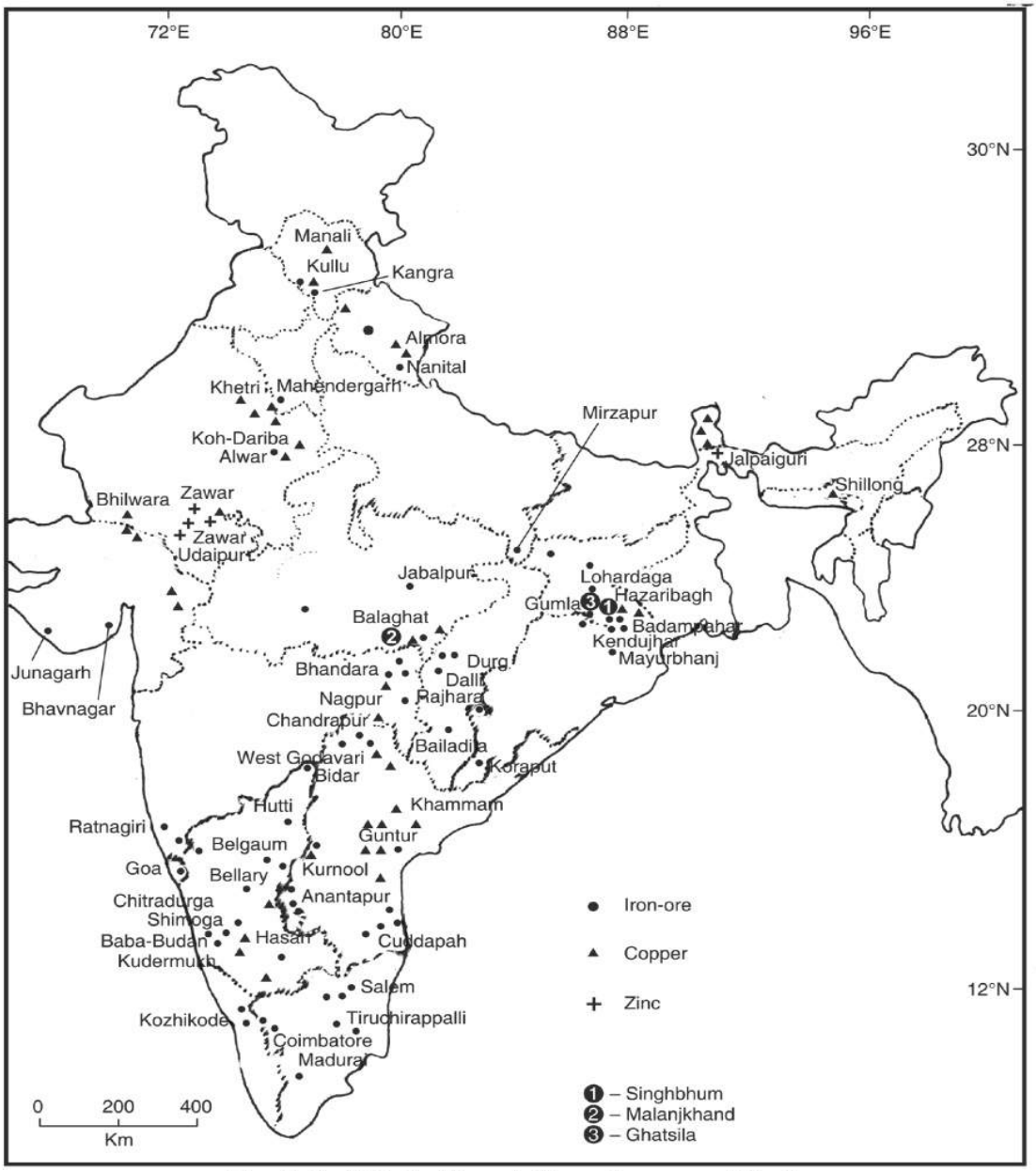

Fig. 7.2 Metallic Minerals (Iron, Copper and Zinc)

(iv) **Siderite:** It is called as *'iron carbonate'*. Its iron content varies between 10 to 40 per cent. It is an inferior variety of iron ore and not economically extractable at most of the places.

Reserves Iron Ore According to the Geological Survey of India, the total reserves of all types of iron ore in the country are 25,500 million tonnes, out of which 14630 million tonnes is of good quality (India-2010). The statewise distribution of Iron ore in the country has been given in **Table 7.1 (Fig. 7.2).**

The production of iron ore in the country after Independence has been shown in **Table 7.1**

Table 7.1 *India: Production of Iron Ore (1950–2006)*

Year	*Production of iron ore (million tonnes)*	*Production growth*
1951	4.15	80.50
1961	18.70	350.5
1971	34.30	83.4
1981	41.60	21.30
1991	54.60	33.60
2001	86.20	21.30
2006	105.00	15.50

Source: ***Year Books & the Statistical Abstracts of India.***

It may be seen from **Table 7.1** that total production of iron ore in 1951 was only 4.15 million tonnes which rose to over 86.20 million tonnes in 2001 and reached 105 million tonnes in 2006. The growth trend of the iron ore production is significantly increasing.

The state-wise production of some of the important states has been given in the **Table 7.2.**

Table 7.2 *India: Production of Iron Ore (2005–06)*

State	*Production in thousand tonnes*	*Percentage of all India production*
Karnataka	25,565	24.90
Odisha	22,560	21.98
Chhattisgarh	20,455	19.92
Goa	18,400	17.92
Jharkhand	14,685	14.32
Others	975	0.96
All India	1,02,640	100.00

Source: ***Statistical Abstract of India***, 2006.

It may be seen from **Table 7.2** that Karnataka is the leading producer of iron ore contributing about 25 per cent of the total production. Odisha contributing about 22 per cent is second in production, while Chhattisgarh and Goa with about 20 per cent and 18 per cent of the total iron ore production in the country are third and fourth respectively. The iron-ore of very high grade are limited to Bailadila (Chhattisgarh) and to a lesser extent in Bellary-Hosepet area of Karnataka and Barajamada sector in Jharkhand and Odisha.

The important iron ore deposits and mining centres have been briefly described in the following section:

1. **Karnataka**: Karnataka is the leading producer of iron ore accounting for about one-fourth of the total ironore production of the country. The high grade deposits belonging to the

haematite and magnetite categories are found in *Kemmangundi* in Bababudan Hills of the Chikmagalur District. The other important iron ore producing districts of Karnataka are Chitradurga, Dharwar, North Kannad, Shimoga, Bellary and Tumkur.

(i) ***Bababudan Hills*:** Lying in Chikmagalur District of Karnataka they stretch over 22 km in length and 20 km in width. They are rich in haematite deposits with ferrous content of 60 to 65 per cent. The iron ore is mainly exported to Iran through the port of Mangalore.

(ii) ***Kudermukh Deposits*:** The Kudermukh iron ore deposits lie in the Chikmagalur District of Karnataka. They contain iron ore of the magnetite category with a metal content of 50 to 65 per cent. The Kudermukh deposits were developed under an export agreement with Iran. The iron ore is exported through the seaport of Mangalore.

(iii) ***Sandur Range*:** The Sandur Range stretches in the Bellary and Hosepet districts of Karnataka. The iron ore of this range is generally hard, compact and steel-grey. The ferrous content varies between 50–65 per cent. Its ore is supplied to the Vijayanagar Steel Plant.

2. **Odisha:** The contribution of Odisha in the total production of iron ore in the country is about 22 per cent. The most important deposits are found at Mayurbhanj (Badampahar), Banspani and Toda in Kendujhar (Keonjhar), Tomka Range in Cuttack, Kandadhar Pahar in Sundargarh, Sambalpur, and Hirapur Hills of Koraput district.

(i) ***Badampahar:*** Situated in the Mayurbhanj District of Odisha, Badam Pahar has rich deposits of iron ore. Its height is about 825 metres above sea level. It has 30 million tonnes of iron ore. Iron-ore from Badampahar is supplied to Bokaro, Durgapur, Jamshedpur, and Raurkela.

(ii) ***Bonaigarh Range:*** Situated in the district of Sundergarh, it is one of the most important iron ore bearing ranges. Iron ore is of haematite category which is supplied to Bokaro, Durgapur, Jamshedpur, and Raurkela.

(iii) ***Mayurbhanj:*** Situated in Odisha, it is well known for the iron ore deposits of haematite type. The metal content is more than 65 per cent. Iron ore from Mayurbhanj mines is sent to the iron and steel plants of Bokaro, Durgapur, Jamshedpur, and Raurkela.

3. **Chhattisgarh**:. This state has about 20 per cent of the total iron ore deposits of the country. Bailadila in the Bastar District and Dalli-Rajhara in the Durg district are the main iron ore producing regions of Chhattisgarh state. The iron ore belongs to the haematite and magnetite categories in which the metal content varies between 60 to 70 per cent. The Bailadila mine is the largest mechanised mine in India. A 270-km long slurry pipeline has been constructed to bring the ore from Bailadila to Vishakhapatnam Plant. The Bailadila iron ore is largely exported to Japan through the port of Vishakhapatnam.

The Dalli Rajhara range is about 32 km long with iron ore reserves of about 125 million tonnes. The ferrous content is about 70 per cent. The deposits of this range are being worked by the Hindustan Steel Plant of Bhilai. Bilaspur, Jagdalpur, Raigarh, and Surguja are the other iron ore producing districts of Chhattisgarh State.

(i) ***Dalli Rajhara*:** The Dalli Rajhara Range, well known for the iron ore depsoits, lies in the Durg District of Chhattisgarh. It is 32 km long with an estimated iron ore deposit of 120 million tonnes. The iron ore is supplied to the Hindustan Steel Plant at Bhilai.

(ii) ***Bailadila:*** Situated in the Bastar District of the Chhattisgarh state, it is known for the rich deposits of iron ore of the haematite category. This iron ore was deposited during the Dharwar Period about 2500 to 1800 million years back. The ore is mostly exported to Japan through the seaport of Vishakhapatnam.

4. **Goa**: Goa is the fourth largest producer of iron ore in India. Goa produces about 18 per cent of the total iron ore of the country. The iron ore of north Goa is of superior quality. The main deposits and mining centres are at Pirna-Adolpale-Asnora, Sanquelim Onda, Kundem-Surla, and Sirigao-Bicholim-Dalda in north Goa. The nearby Marmagao seaport is a big advantage to these mines for the export of iron ore. The iron ore is exported mainly to Japan and Iran.
5. **Jharkhand :** Jharkhand has 25 per cent of the iron ore reserves and accounts for about 14 per cent of the total production of iron ore of the country. Iron ore mining was first of all started at Singhbhum in 1904. The main iron ore deposits lie in Bonai Ragne extending for about 50 km. The famous mines are Naomandi, Daltenganj (Palamu District). Iron ore is also mined at Dhanbad, Hazaribagh, Ranchi, and Santhal Pargana.

Other States: Iron ore in small quantities is also mined in Maharashtra, (Chandrapur, and Ratnagiri); Tamil Nadu (Coimbatore, North Arcot, Ambedkar, Madurai, Salem, Tiruchirapalli, Tirunelveli); Andhra Pradesh (Anantapur, Cuddapah, Guntur, Khammam, Kurnool, Nellore); Rajasthan (Alwar, Bundi, Bhilwara, Jaipur, Sikar, Udaipur); Uttar Pradesh (Mirzapur), Uttarakhand (Almora, Garhwal, and Nainital); Himachal Pradesh (Kangra and Mandi); Haryana (Mahendergarh); West Bengal (Birbhum, Burdwan, Darjeeling); Jammu & Kashmir (Udhampur and Jammu); Gujarat (Bhavnagar, Junagarh, Vadodra); and Kerala (Kozhikode).

Export: India is the fifth largest exporter of iron ore in the world. About 55 per cent of our total iron ore production is exported to Japan, South Korea, West European countries, Iran, United Arab Emirates and other Gulf countries. Most of the export is made through the ports of Vishakhapatnam, Paradwip, Marmagao, and Mangalore.

Manganese India has the second largest reserves of manganese in the world after Zimbabwe, and is the fifth largest producer after Brazil, Gabon, South Africa, and Australia (**Fig. 7.3).** It is used mainly for the manufacturing of iron and steel, bleaching powder, insecticides, pesticides, paints, dry-batteries, photography, etc. The total reserves of manganese-ore in the country are placed at 380 million tonnes (India-2010) The regional distribution of manganese has been given in **Table 7.3.**

Table 7.3 *India: Distribution of Manganese (2005–06)*

State	*Production in thousand tonnes*	*Percentage of all India*	*Districts/mining centres*
1. Odisha	715	38.55	Sundargarh, Kalahandi, Koraput, Bolangir and Sambhalpur
2. Maharashtra	425	22.91	Nagpur, Bhandara and Ratnagiri
3. Madhya Pradesh	365	19.68	Balaghat and Chhindwara
4. Karnataka	245	13.20	North Kannada, Shimoga, Bellary, Chitradurga, and Tumkur
5. Andhra Pradesh	85	4.58	Srikakulam, Vishakhapatnam, Cuddapah, Vijaynagram, and Guntur

(*Contd.*)

(*Contd.*)

6. Others	20	1.08	Goa, Panchmahal and Vadodara (Gujarat), Udaipur, Banswara (Rajasthan), Singhbhum, Dhanbad, (Jharkhand).
All India	1855	100.00	

Source: ***Statistical Abstract of India*, 2007**.

1. **Odisha:** The state of Odisha is the single most important state in the production of manganese accounting for over 38 per cent of the total production. The Gondite deposits in Sundargarh and khondolite and kodurite deposits in Kalahandi and Koraput are rich in manganese. Manganese is also mined in Bolangir and Sambhalpur districts of Odisha.
2. **Maharashtra:** Maharashtra is the second largest producer of Manganese, accounting for about 23 per cent of the total production. In Maharashtra, manganese is found in Bhandara, Nagpur, and Ratnagiri districts. The Ratnagiri ore is, however, of superior quality.
3. **Madhya Pradesh:** About 20 per cent of the total manganese production comes from the state of Madhya Pradesh. Balaghat and Chhindwara are the main districts in which it is mined.
4. **Karnataka:** The state of Karnataka produces about 13 per cent of the total production of manganese of the country. Its main deposits are in the districts of North Kannada, Shimoga, Bellary, Chitradurga, and Tumkur.
5. **Andhra Pradesh:** About four-and-a-half per cent of the total manganese production of India is done in Andhra Pradesh. Srikakulam and Vishakhapatnam are the leading producer districts of manganese in Andhra Pradesh. It is also mined in Cuddapah, Guntur, and Vijayanagram.

In addition to these, manganese is also mined in small quantities in Goa, Gujarat (Panchmahal and Vadodara); Rajasthan (Banswara and Udaipur); Jharkhand (Dhanbad and Singhbhum). The growth pattern and production of manganese in India has been shown in **Table 7.4**.

Table 7.4 *India: Production of Manganese Ore (1950–2006) (in lakh tonnes)*

Year	*Production (in lakh tonnes)*
1950–51	13.98
1960–61	14.05
1970–71	18.41
1980–81	15.32
1990–91	13.88
2000–01	15.95
2005–06	17.65

Source: ***Statistical Abstracts of India,*** 2007.

It may be seen from **Table 7.4** that in 1950–51 the total production of manganese was only about 14 lakh tonnes which rose to over 17 lakh tonnes in 2005–06.

Nearly 80 per cent of the manganese production is consumed within the country, while the remaining is exported to USA, UK, Germany, France, Italy, Netherlands, Belgium, Czech Republic, Slovakia, and East European countries including Ukraine.

Fig. 7.3 Metallic Minerals

Copper Copper is highly ductile, strong and good conductor of electricity. It is mainly used in electrical machinery, automobile, stainless steel. When alloyed with zinc, it is known as 'brass' and with tin as 'bronze. Rajasthan has the largest deposits of copper-ore followed by Madhya Pradesh, and Jharkhand. In the production of copper-ore, however, Madhya Pradesh stands first, followed by Rajasthan and Jharkhand. The total resources of copper are about 1.39 billion tonnes with a metal content of 11,418 thousand tonnes (India 2012, p. 7633). The distribution of copper in India has been given in **Table 7.5.**

Table 7.5 *India: Distribution of Copper (2005–06)*

State	*Production in thousand tonnes*	*Percentage of all India*	*Districts/mining centres*
1. Madhya Pradesh	89	55.97	Malanjkhand (Balaghat), Bargaon (Betul)
2. Rajasthan	65	40.88	Jhunjhunu (Khetri-Singhana), Bhilwara, Ajmer, Chittorgarh, Dungarpur, Jaipur, Pali, Sikar, Sirohi
3. Jharkhand	05	03.15	Hazaribagh, Santhal Pargana
All India	159	100.00	

Source: ***Statistical Abstracts of India***, 2007.

1. **Madhya Pradesh**: The state of Madhya Pradesh is the largest producer of copper in India. The state has a large deposit of copper in Taregaon in Malanjkhand belt of Balaghat District. It is also found in Bargaon of the Betul district.
2. **Rajasthan:** Copper is found at Khetri-Singhana belt in Jhunjhunu District. It is also mined in Ajmer, Alwar, Bhilwara, Chittorgarh, Dungarpur, Jaipur, Pali, Sikar, and Sirohi districts. The Koh-Dariba (mountain), about 48 km to the south-west of Alwar city and Delwara-Kirovli area about 30 km from Udaipur are the other important producers of copper ore.
3. **Jharkhand:** It is the third largest producer state of copper in the country. Copper is mined in Hazaribagh, Santhal Pargana (Jharkhand), Gaya, and Palamu districts (Bihar).

Table 7.6 *India: Production of Copper (1950–2006)*

Year	*Production in thousand tonnes*
1950–51	375
1960–61	423
1970–71	666
1980–81	2110
1990–91	5255
2000–01	164
2005–06	156

Source: ***Statistical Abstracts of India***, 2007.

It may be observed from **Table 7.6** that the highest production of copper was in 1990–91 when it reached 5255 thousand tonnes. Its production has a declining trend during the last 25 years as in 2005–06 only about 156 thousand tonnes of copper was produced.

Not being self-sufficient in copper, India is importing substantial quantity of copper from Zimbabwe, Australia, USA, Mexico, and Japan.

***Chilpi Series*:** It stretches over parts of Balaghat, and Chhindwara districts of Madhya Pradesh. The series consists of quartzite, copper-pyrite, mica schist, and marble. The copper obtained from this series is used in the Malanjkhand Copper Plant.

Ghatsila: Located in Jharkhand, it is a copper smelting plant. It is an electrolytic refinery. It manufactures brass sheets. It also obtains gold, silver, and nickel in the processing of copper.

Khetri: It is an integrated copper mining-cum-ore refining plant in the Jhunjhunu District of Rajasthan. It was established in 1967. It also obtains copper ore from the Malanjkhand copper mines of Madhya Pradesh. It also has a sulphuric acid plant, and a fertiliser plant.

Korba: Bharat Aluminium Company Limited (BALCO) has an aluminium plant located at Korba, Bilaspur District of Chhattisgarh. It obtains bauxite deposits from the Amarkantak region and electricity from the Korba Thermal Power Plant. The government has disinvested its share to a private company, Sterlite.

Malanjkhand: It is an open cast copper mine in Balaghat District of Madhya Pradesh. A copper plant has been established at Malanjkhand. The copper ore is also sent to the Khetri Copper Plant of Rajasthan.

Rakha Project: The Rakha copper Plant is located in the Rakha District of Singhbhum of Jharkhand. It obtains copper ore from the mines of Rakha.

Tajola: The Tajola Copper Plant is located in the Raigadh town in Maharashtra. The plant has imported copper cathodes. It manufactures copper rods.

Chromite Chromite is an oxide of iron and chromium. It is widely used in metallurgical and chemical industries. Odisha, accounting for about 99 per cent of the total production, is the largest producer of chromite. It is mined in Cuttack, Dhenkanal and Keonjhar districts. Karnataka is the second largest producer. In Karnataka, it is mined in Hassan district. Some chromite has been discovered in the Krishna District of Andhra Pradesh and the Tamenglong and Ukhrul districts of Manipur.

Uranium It is mined at Jaduguda, Bhatin, Narwapahar and Turamdih (Singhbhum East), Jharkhand.

Lead Lead is widely used because of its heaviness, malleability, softness and bad conductivity of heat. It is used in alloys, cable cover, lead-sheeting, ammunition, paints, glass making, paints making, automobiles, aeroplanes, type-writers, calculating machines, printing and rubber industry. Lead does not occur free in nature. It is obtained from galena which is found in association with limestone, sandstones and calcareous slates. According to an estimate, India has lead reserves of about 525 million tonnes (India 2010).

Table 7.7 *Production of Lead in India (1950–2006)*

Year	*Production in thousand tonnes*
1950–51	1.81
1960–61	5.53
1970–71	4.26
1980–81	19.95
1990–91	44.23
2000–01	54.49
2005–06	63.50

Source: ***Statistical Abstracts of India,*** 2007.

Rajasthan is the leading producer of lead. It is mined in Udaipur (Zawar, Rikhabdeo, and Debari), Dungarpur (Ghugra and Mando), Banswara, and Alwar districts.

In Andhra Pradesh its deposits are in Cuddapah, Guntur, Khammam, Kurnool, North Arcot-Ambedkar and South Arcot (Tamil Nadu). It is also mined in Uttarakhand (Tehri, and Pithoragarh);

Jharkhand (Hazaribagh, Palamu, Ranchi, and Singhbhum); in Madhya Pradesh (Gwalior, Hoshingabad and Shivpuri); Himachal Pradesh (Kangra and Kullu); Jammu and Kashmir (Baramulla and Udhampur); and West Bengal (Jalpaiguri and Darjeeling districts).

India is not self-reliant in lead and therefore, has to import about 75 per cent of its requirements from Australia, Canada, and Myanmar.

Zinc Zinc is found in association with lead and silver. It is mainly used for alloying and for manufacturing galvanised sheets. It is also used for dry-batteries, white pigments, electrodes, textiles, die-casting, rubber industry, and for making collapsible tubes containing drugs, and pastes.

Rajasthan is the leading producer of zinc accounting for about 99 per cent of the total production. Small quantities of zinc are obtained from Sikkim, Jammu, Bihar, M.P., Maharashtra, Tamil Nadu, Meghalaya and Kashmir (Udhampur District), and South Arcot Vallalar of Tamil Nadu. India imports about 80 per cent of its requirements from Australia, Canada, Russia, and Zaire. The total production of zinc in 2008–09 was 1145 thousand*

Tungsten Tungsten is obtained from the wolfram ore. It is a self hardening mineral and therefore, used in steel industry, manufacturing of ammunition, armour plates, heavy guns, hard-cutting tools, etc. The total resources of Tungsten ore in the country are about 88 million tonnes.

Tungsten deposits are found at Degana near Rawat Hills in Rajasthan, Bankura District of West Bengal, Sakoli basin in Bhandara and Nagpur districts of Maharashtra, and Kolar mines in Mysore. It is also found in Chittoor, and East Godavari District of Andhra Pradesh, Ahmedabad District of Gujarat, and Singhbhum District of Jharkhand.

Bauxite Aluminium is obtained from bauxite. Bauxite is an oxide of aluminium. It is not a specific mineral but a rock consisting mainly of hydrated aluminium oxides. It is a clay like substance which is pinkish, whitish or reddish in colour depending on the amount of **iron content.** The total reserves of bauxite are about 3290 million tonnes (India, 2010, p. 690).

Table 7.8 *India: Production of Bauxite (1950–51 to 2005–06)*

Year	*Production in thousand tonnes*
1950–51	68
1960–61	476
1970–71	1517
1980–81	1955
1990–91	4984
2000–01	8689
2005–06	9854

Source: ***Statistical Abstracts of India,*** 2007.

It may be observed from **Table 7.8** that the production of bauxite has increased from 68 thousand tonnes in 1950–51 to 9854 thousand tonnes in 2005–06. Still, India has to import a substantial proportion of its requirements from abroad.

The distribution and production of bauxite in the different states of India has been given in **Table 7.9 (Fig. 7.3).**

*tonnes (India 2010, p.690).

Table 7.9 *India: Production of Bauxite (1950–2006)*

State	*Production in thousand tonnes*	*Percentage of All India*	*Main districts/mining centres*
Odisha	4904	50.16	Kalahandi, Koraput, Sundargarh, Bolangir and Sambalpur.
Gujarat	1547	15.82	Amreli, Bhavnagar, Jamnagar, Junagarh, Kuchchh
Jharkhand	1161	11.87	Dumka, Lohardaga, Munger, Palamu, Ranchi.
Maharashtra	964	9.87	Kolhapur, Pune, Ratnagiri, Satara Thane
Chhattisgarh	604	6.18	Amarkantak Plateau, Bilaspur, Durg, Raigarh, Surguja
Tamil Nadu	268	2.74	Madurai, Nilgiri and Salem districts
Madhya Pradesh	230	2.35	Balaghat, Katni, Jabalpur, Maikala Range, Mandla, Shahdol.
Others	99	1.04	Andhra Pradesh, Goa, Jammu & Kashmir and Kerala
All India	9777	100.00	

Source: ***Statistical Abstracts of India,*** 2007.

1. **Odisha:** Odisha stands first in the production of bauxite, producing more than 50 per cent of the total bauxite. The Kalahandi-Koraput belt which extends into Andhra Pradesh is the main bauxite deposit region. In addition to this, bauxite is also obtained from the districts of Bolangir, Sambalpur and Sundargarh. The new aluminium plant located at Damanjoli and Doragurha provide a good market for bauxite in this region.
2. **Gujarat**: About 16 per cent of the total bauxite production is from the state of Gujarat. In Gujarat, the main bauxite depsoits are found between the Gulf of Kachchh and the Gulf of Khambat (Arabian Sea) through the districts of Bhavnagar, Junagarh, and Amreli. It is mined in Kheda and Sabarkantha.
3. **Jharkhand–Bihar**: In Jharkhand, bauxite is obtained from Dumka, Gumla, Lohardaga, Munger, Palamu, and Ranchi districts. The Lohardaga mines are, however, known for high grade bauxite deposits.
4. **Maharashtra**: About 10 per cent of the total bauxite production comes from Maharashtra. Kolhapur, Pune, Ratnagiri, Satara, and Thane are its main producing centres.
5. **Chhattisgarh:** In Chhattisgarh, bauxite is obtained from the Maikal Range, Amarkantak Plateau, Bilaspur, Raigarh, and Surguja. Its share in the total production is about 6 per cent.
6. **Tamil Nadu:** The Madurai, Nilgiri and Salem districts are known for the production of bauxite accounting for about 2.75 per cent of the total production.
7. **Madhya Pradesh**: In Madhya Pradesh, bauxite is mined in the districts of Balaghat, Jabalpur, Katni, Mandla, and Shahdol.

Bauxite is also mined in the states of Andhra Pradesh (East Godavari, West Godavari, and Vishakhapatnam districts); Kerala (Kannur, Kollam, Thiruvananthapuram); Rajasthan (Kota); Uttar Pradesh (Banda, Lalitpur), Goa, and Jammu and Kashmir (Jammu, Poonch and Udhampur districts).

Nearly 80 per cent of the total bauxite produced is used for the production of aluminium. Italy and UK are the largest importers of Indian bauxite accounting for 60 per cent and 25 per cent of the total export respectively. The remaining is exported to Germany, Belgium, and Japan. Some of the important aluminium plants are as under:

Balco: The Bharat Aluminium Company Limited (BALCO) was incorporated on 27 November, 1965 as a Central Public Sector Undertaking with an integrated Aluminium Complex at Korba (Chhattisgarh). The Government of India disinvested 51 percent equity in the company along with the transfer of management control in favour of M/s Sterlite Industries (India) Limited with effect from 2nd March 2001, and consequently, the company has ceased to be a public sector undertaking.

Renukoot (HINDALCO): The Renukut aluminium plant was commissioned in 1958 about 160 km away from Mirzapur (Uttar Pradesh). It obtains bauxite from Lohardaga (Jharkhand) and electricity from the Rihand Dam, and the thermal power station near the plant.

Madras Aluminium Company (MALCO): This aluminium plant was commissioned in 1965 near the Mettur Dam (Salem District). It obtains bauxite from the Shevaroy Hills (Tamil Nadu) and electricity from the Mettur Hydel Project.

Koraput Aluminium Plant (NALCO): The Koraput aluminium plant was commissioned in the Koraput District in 1981. This plant was running in loss and therefore, the central government disinvested in this plant in 2006.

Gold Gold is a precious metal used for making ornaments, and is known as an international currency. India has about 390 million tonnes with a metal content of 491 tonnes of gold ore reserves (India 2010). The production of gold in India has been shown in **Table 7.10.**

Table 7.10 *India: Production of Gold (1951–2011)*

Year	*Production in kg.*
1951	7041
1961	4868
1971	3656
1981	2495
1991	2208
2001	2615
2011	3900

Source: ***Statistical Abstracts of India***, 2011.

It may be seen from Table 7.10 that the total production of gold in the country was 7041 kg in 1950–51 which declined to 3900 kg in 2011. About 90 per cent of the total gold is produced in the Karnataka state followed by Rajasthan, West Bengal, Jharkhand, Bihar and Andhra Pradesh. There are three important gold fields in the country, namely, (i) Kolar Gold Field, Mysore (Karnataka), (ii) Hutti Gold Field in Raichur (Karnataka), and (iii) Ramgiri Gold Field in Anantapur District (Andhra Pradesh).

Kolar Gold Mines: Mining from the Kolar Gold Fields was started first in 1871. This field still contributes about 60 per cent of the total gold production in the country. The gold mines of Kolar Field are more than 3000 metres deep. Most of the gold has already been taken out and it is not economically viable to extract gold from a depth of more than three kilometers.

1. **Karnataka:** Karnataka stands first in the reserves and production of gold in India. It is obtained mainly from the Kolar, Dharwar, Hassan and Raichur districts. Some gold deposits have also been found in Belgaum, Bellary, Chikmaglur, Gulbarga, Mandya, and Shimoga districts. Hutti Gold Mine Company is India's only producer of gold.
2. **Andhra Pradesh**: Andhra Pradesh is the second largest producer of gold in India. The main deposits of gold in Andhra Pradesh are found in Ramagiri (Anantapur District). In addition to this, gold is also found in Chittoor and Kurnool districts.

Placer or Alluvial Gold: The gold obtained from the sand and sedimentary deposits of the rivers is known as placer gold. Placer gold is found in the Subarnrekha (Gold Streak) river of Jharkhand. Placer gold is also found near Lowa in Singhbhum District and some other parts of the Chotanagpur Plateau.

Placer gold is also found in the sand of Dras, and Suru rivers of Kargil (J & K), Shimla and Bilaspur in Himachal Pradesh, Punna-Puzha and Chaiyar Puzha rivers of Kerala, Balaghat and Seoni districts of Madhya Pradesh, Bastar, Raigarh, and Raipur of Chhattisgarh and and Purulia District of West Bengal.

Champion Series: It is named after Champion reef in the Kolar Gold Field. It is the oldest gneiss in Karnataka. In fact, it is one of the oldest metamorphic sedimentary deposits in India. Known for its gold deposits, it has quartz and muscovite.

Silver Silver is also a precious metal. India, however, is not very rich in silver deposits. It is an important currency metal, and used in the manufacture of chemicals, electroplating, photography, and coloring for glasses.

It is found in association with lead and zinc. Zawar mines of Udaipur (Rajasthan) are the largest producer of silver. In Hindustan Zinc Smelter (Udaipur), it is obtained as a by-product of zinc and lead smelting. The Tundoo Lead Smelter in Dhanbad (Jharkhand) is also an important source. Silver is also produced by Kolar Gold Fields and Hutti Gold mines (Raichur) of Karnataka during refining of gold. The Hindustan Copper Limited at Maubhandar Smelter (Singhbhum, Jharkhand) obtains silver from copper mines. Silver is also produced at the Vishakhapatnam Smelter in Andhra Pradesh from lead concentrates.

Non-Metallaic Minerals

India is fairly rich in the non-metallic minerals also. The geographical distribution of some of the important non-metallic minerals has been shown in **Fig. 7.4**.

Mica (Abhrak) Mica is an important non-metallic mineral used mainly in electrical industry as it has great insulating properties, can withstand high voltage and has low power loss factor. It is obtained from muscovite, biotite and phlogopite ores. The total reserves of mica in the country are estimated to be about 3.9 lakh tonnes (India 2010) (**Table 7.11**). Rajasthan accounts for about 51 per cent resources, followed by Andhra Pradesh, Maharashtra and Bihar (India 2012, p. 766)

Fig. 7.4 Metallic Minerals

Table 7.11 *India: Distribution of Mica (2005–06)*

State	*Production in tonnes*	*Percentage of all India*	*Districrts/Mining centres*
1. Andhra Pradesh	910	71.15	Nellore, Krishna. Khamma, Vishakhapatnam, West Godavari.
2. Rajasthan	205	16.03	Ajmer, Bhilwara, Dungarpur, Jaipur, Sikar, Tonk, Udaipur.
3. Jharkhand	148	11.57	Dhanbad, Gaya, Gridh, Hazaribagh, Munger, Ranchi, Singhbhum
4. Bihar	016	1.25	Bhagalpur
All India	1279	100.00	

Source: ***Statistical Abstracts of India***, 2007.

1. **Andhra Pradesh**: Andhra Pardesh is the largest producer of mica. It produces more than 71 per cent of the total mica production of the country. The micabelt of Nellore is about 100 km long and 25 km wide. Nellore mica is generally light green in colour. Mica is also obtained from Dudur, Khamma, Krishna, West Godavari, and Vishakhapatnam.
2. **Rajasthan:** The main mica belt of Rajasthan extends from Jaipur to Udaipur. It is also mined at Ajmer, Bhilwara, Dungarpur, Sikar, and Tonk.
3. **Jharkhand and Bihar:** Mica in Jharkhand and Bihar is found in a belt extending for about 150 km in length and 32 km in width from the eastern part of Gaya through Hazaribagh, Giridh, and Munger to Bhagalpur. The main centre of mica production in Jharkhand and Bihar are Kodarma, Dhorhakola, Dhab, Tisri, Chakai.

Mica is also found in Gujarat (Banaskanth, Vadodara and Sabarkantha); Tamil Nadu (Nilgiri, Coimbatore, Salem, and Tiruchirapalli), Chhattisgarh (Bilaspur, Bastar, and Surguja); Madhya Pradesh (Balaghat and Chhindwara); and Uttar Pradesh (Mirzapur). Some deposits are also found in Haryana, Himachal Pradesh, Odisha, and West Bengal.

Table 7.12 *India: Production of Mica (1950–2006)*

Year	*Production in tonnes*
1950–51	10.0*
1960–61	28.35
1970–71	1510
1980–81	8534
1990–91	4746
2000–01	3806
2005–06	1154

*Relates to dressed mica.
Source: ***Statistical Abstracts***, 2007.

It may be seen from **Table 7.12** that the production of mica was about ten tonnes in 1950–51 which rose to 3806 tonnes in 2000–01 and 1154 tonnes in 2005–06.

India is the largest producer and exporter of mica in the world. It exports mica to Japan, USA, UK, Norway, Russia, Germany, France, Belgium, Netherlands, Poland, Czech Republic, Slovakia, and Hungary.

Saucer Series: It sprawls over Nagpur, Bhandar (Maharashtra), and Chhindwara district (Madhya Pradesh). Saucer series belongs to the Dharwarian Group. It largely consists of quartzite, mica-schist, marble and magniferous rocks. Its mica is of light green colour.

***Sakoli Series*:** It spreads over Jabalpur and Rewa districts of Madhya Pradesh. It is rich in mica schist, quartz, dolomite, and marble. The famous Jabalpur marble is obtained from the Sakoli Series. It also contains gneisses of the Dharwar period.

Limestone: Limestone is an aggregate of calcium carbonate, carbonate of calcium and magnesium or a mixture of the two. Limestone also contains small quantities of silica, alumina, iron-oxides, phosphorus and sulphur. Limestone deposits are of sedimentary origin and exist in almost all the geological formations from the Pre-Cambrian to Recent except in Gondwana.

Limestone is used in cement, iron and steel, and chemical industries. The rapid industrialisation and urbanisation has resulted into heavy demand of this mineral, especially for the manufacturing of cement. The production trend of limestone in the country has been given in **Table 7.13**.

***The Semri Series*:** This is the main series of the Lower Vidhyan formations in the Son valley. Its thickness is about 900 metres of limestonnes, shales and sandstone with intrusive dolerites and basalt. The upper most stage, known as Rohtas Stage is composed of limestone and shales which provides raw material to the cement industry in the region.

Table 7.13 *India: Production of Limestone (1950–2006)*

Year	*Production in lakh tonnes*
1950–51	30.00
1960–61	148.00
1970–71	151.00
1980–81	324.50
1990–91	685.00
2000–01	1275.00
2005–06	1620.00

Source: ***Statistical Abstract of India,*** 2007.

It may be seen from **Table 7.13** that in 1950–51 the total production of limestone was only 30 lakh tonnes which rose to 1620 lakh tonnes in 2005–06.

Limestone in some quantity is produced in almost all the states of India. Its main producing states are Rajasthan, Madhya Pradesh, Andhra Pradesh, Gujarat, Chhattisgarh, and Tamil Nadu. The production and percentage of limestone in the important states of the country have been given in **Table 7.14.**

Dolomite: Dolomite is a type of limestone which contains more than 10 per cent of magnesium. It is used mainly in the metallurgical industry, especially in the iron and steel industry. The total reserves of all grades of dolomites are 7533 million tonnes (India 2012). The states of Odisha, Chhattisgarh, Andhra Pradesh, Jharkhand, Rajasthan, Gujarat, Maharashtra and Karnataka are its main producers contributing 90% of the total production (**Fig. 7.5**). The state-wise distribution of dolomite has been given in **Table 7.15.**

Table 7.14 *India: Distribution of Limestone (2005–06)*

State	*Production in lakh tonnes*	*Percentage of all India production*	*Main districts/ mining centres*
Rajasthan	240	16.15	Ajmer, Alwar, Bikaner, Chittaurgarh Dungarpur, Kota, Nagaur, Pali
Madhya Pradesh	238	16.01	Betul, Damoh, Jabalpur, Rewa, Satna, Sagar
Andhra Pradesh	235	15.81	Cuddaph, Guntur, Kurnool, Krishna, Nalgonda, Warangal
Gujarat	160	10.77	Amreli, Junagarh, Kheda, Surat
Chhattisgarh	140	9.42	Bastar, Bilaspur, Durg, Raigarh, Raipur
Tamil Nadu	138	9.29	Coimbatore, Madurai, Salem, Thanjavur
Karnataka	125	8.41	Bijapur, Gulbarga, Shimoga
Maharashtra	90	6.06	Chandrapur, Nanded, Ahmednagar, Yavatmal
Himachal Pradesh	68	4.58	Bilaspur, Chamba, Kangra
Odisha	25	1.68	Kalahandi, Sambalpur, Sundargarh
Others	27	1.82	Dehradun, Mussoorie, Darjeeling, Jammu, Ambala, Mahendargarh, Mirzapur
All India	1486	100.00	

Source: ***Statistical Abstracts of India,*** 2007.

Table 7.15 *India: Distribution of Dolomite (2005–06)*

State	*Production in thousand tonnes*	*Percentage of all India production*	*Districts/mining centres*
1. Odisha	1075	28.71	Gangapur, Koraput, Sambalpur, Sundargarh
2. Chhattisgarh	1025	27.38	Bastar, Bilaspur, Durg, Raigarh
3. Andhra Pradesh	687	18.35	Anantapur, Kurnool and Khammam
4. Jharkhand	295	0 7.88	Chaibasa, Singhbhum Ajmer,
5. Rajasthan	215	0 5.74	Alwar, Bhilwara, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagaur, Pali, Sawai Madhopur, Sikar and Udaipur
6. Karnataka	212	05.66	Belgaum, Bijapur, Chitradurga, Mysore, Uttar Kannada, and Tumkur
Others	235	06.28	Arunachal Pradesh, Haryana, Himachal Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal
All India	3744	100.00	

Source***: Statistical Abstract of India,*** **2007.**

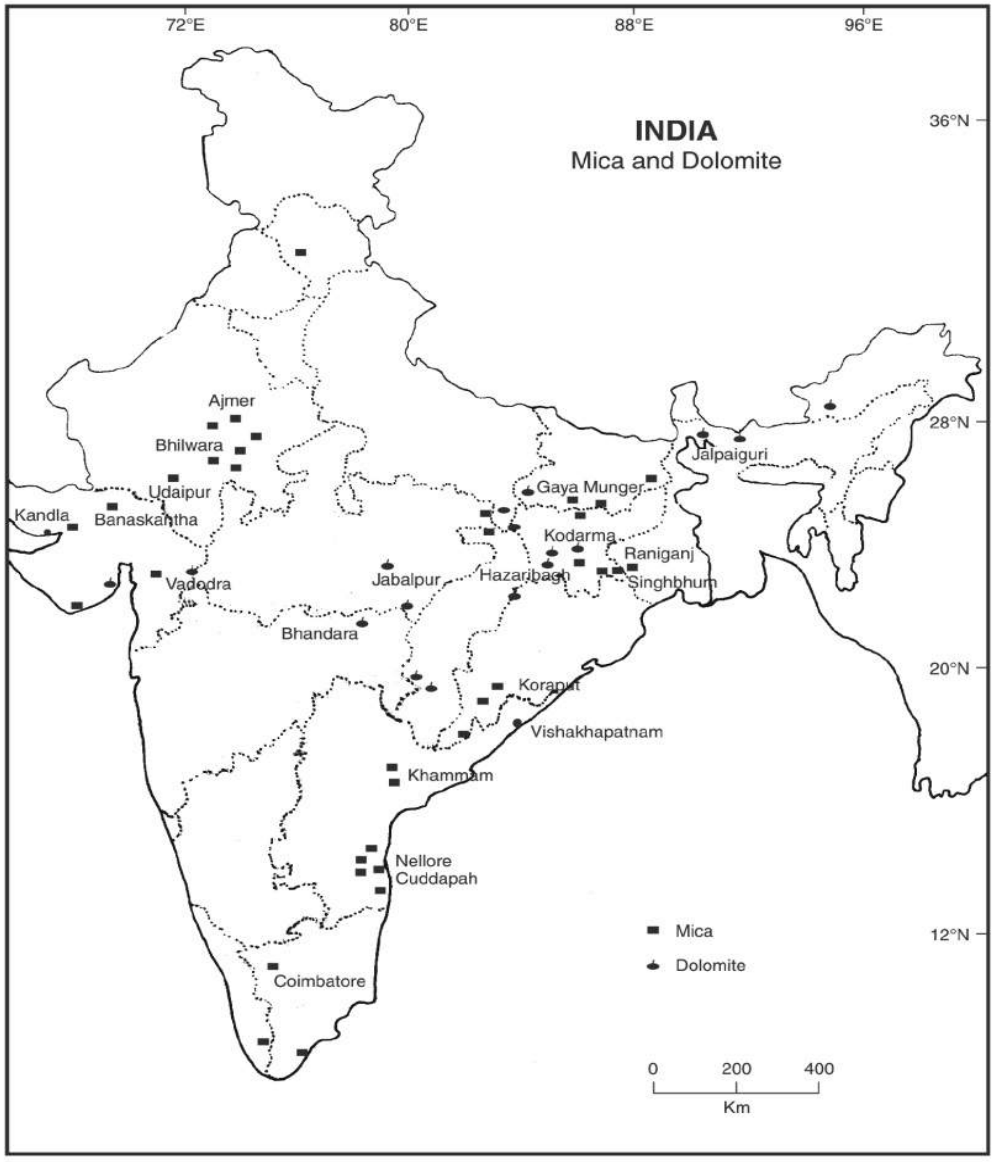

Fig. 7.5 Non-metallic Minerals

1. Odisha is the leading producer of dolomite accounting for about 29 per cent of the total production in the country, followed by Chhattisgarh with over 27 per cent. The share of Andhra Pradesh and Jharkhand is 18.35 per cent and about 8 per cent respectively in the total production. Rajasthan and Karnataka contribute about 6 per cent each. It is mined in several other states also as given in **Table 7.15.**

Asbestos: Asbestos has great commercial value due to its fibrous structure, and its resistance to fire. It is widely used for making fire-proof clothes, rope, paper, sheeting, belt, fireproof safes, insulators, felts, aprons, gloves, curtains, brake linings in automobiles, and insulating mats. Asbestos cement products like sheets, slates, pipes and tiles are used for building purposes. Mixed with magnesia, it is used for making 'magnesia bricks' used for heat insulation.

Rajasthan is the leading producer accounting for about 95 per cent of the total asbestos production of India. It is mined in Ajmer, Alwar, Dungarpur, Pali and Udaipur districts. Andhra Pradesh is the second largest producer. It is produced in Cuddapah District. It is also mined in Karnataka, Jharkhand, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Uttarakhand, and Nagaland.

Magnesite: Magnesite is used for manufacturing refractory bricks, special type of cement, tiles, fire-proof flooring and for extraction of the metal magnesium, and in steel industry. The total reserves of magnesite in India are about 338 million tonnes (India 2012). Its major deposits are found in Uttarakhand (68%), Rajasthan (16%) and Tamil Nadu (13%) . Its deposits have also been found in Jammu and Kashmir, Karnataka, Himachal Pradesh, and Kerala.

Tamil Nadu is the largest producer accounting for over 74 per cent of the total magnesite production, followed by Uttarakhand (20 per cent) and Karnataka (6 per cent).

Kyanite: Found in the metamorphic rocks, kyanite is used in metallurgical, ceramic, refractory, glass and electrical industries. The total reserves of Kyanite are 103 million tonnes. India is the largest producer of kyanite in the world. Kyanite deposits are located in Jharkhand, Maharashtra, and Karnataka. These three states contribute almost the whole production of kyanite of the country.

Gypsum: Gypsum is a hydrated sulphate of calcium which occurs as a white opaque mineral in beds of bands of sedimentary rocks like limestone, sandstone and shale. It is mainly used in making ammonia sulphate, fertilisers and in cement industry. It is also used in making plaster of Paris, ceramic industry, nitrogen-chalk, partition-blocks, sheets, tiles, and plastics.

The total reserves of gypsum are about 1237 million tonnes. Rajasthan is the leading producer of gypsum accounting for about 99 per cent of the total production of the country. It is obtained mainly from the districts of Barmer, Bikaner, Churu, Ganganagar, Jaisalmer, Jodhpur, Nagaur, and Pali. The remaining one per cent is mined in Tamil Nadu, Jammu and Kashmir, Gujarat, and Uttarakhand, Andhra Pradesh, Himachal Pradesh, Karnataka, and Madhya Pradesh. The total reserves of gypsum in India were estimated to be about 1237 million tonnes (India 2010).

Sillimanite: Sillimanite is used is ceramics, metallurgy, glass, refractory, automobiles and cement manufacturing industries. Its main characteristic is that it can withstand high temperatures.

The total reserves of sillimanite are 74 million tonnes. Odisha, contributing about 57 per cent of the total production, is the largest producer of sillimanite in India. Kerala is the second largest producer accounting for about 33 per cent of the total production. It is also produced in Maharashtra, Rajasthan, Meghalaya, Assam (Karbi-Anglong), Madhya Pradesh, (Sidhi), West Bengal (Darjeeling, Bankura and Purulia), and Tamil Nadu (Kanniyakumari, Tirunelveli, and Tiruchirappalli).

Diamond: Diamond is a precious stone. It is known for its brilliance, luster, transparency and hardness. Diamond is mainly found in the Vindhyan formations of Bundelkhand, (M.P.), Andhra Pradesh (Kurnool, Anantapur), and Karnataka (Raichur). Panna District of Madhya Pradesh is the main diamond producing district in India. In India, the total diamond reserves is about 45.8 lakh crates (India, 2010).

Cutting and polishing of diamond is mainly carried on in Surat, Ahmedabad, Navasari, Palanpur, Bhavnagar, Mumbai, Khambat, Jaipur, Trichur, and Goa.

***Ajabgarh Series*:** Lying in the Rajasthan state, the Ajabgarh Series belongs to the Cuddapah and Lower Vindhyan group. It is rich in biotite-schist, quatzites, and impure limestonnes. It has inferior quality of iron ore, manganese, asbestos, slate, marble, and jasper.

***Bhander Series*:** It belongs to the Vindhyan formation. The main rocks in the Bhander Series are sandstone, shale and limestone. The series provides good quality of building material besides diamond mines. The diamonds from the Bhander series are sent to Surat and Jaipur for polishing and finishing.

Bijwara Series: It occupies parts of Chhatarpur and Panna districts of Madhya Pradesh. It is composed of sandstone, quartzite and limestone. It has basaltic intrusions whose dykes are rich in diamonds. The Panna diamond is famous all over the world for its transparency, brilliance, and hardness.

***Rialo Series*:** This series stretches from Delhi to Alwar. It belongs to the Archaean and Dharwarian groups. The famous marbles of Makrana, Rajnagar, and Bhagwanpura belong to this series. Limestone, marble, quartzite, and building material are the main minerals found in this series.

Atomic Minerals: Uranium and thorium are the main atomic minerals.

Uranium: deposits occur in Singhbhum and Hazaribagh districts of Jharkhand, and Gaya District of Bihar, and in sedimentary rocks of Saharanpur District of Uttar Pradesh. The largest source of uranium comprise the monazite sands, both beach and alluvial. Monazite sand rich in uranium is found in Kerala. Some uranium is found in the copper and zinc mines of Udaipur (Rajasthan). The total reserves of uranium as estimated by the Department of Atomic Energy, Government of India, are about 31,000 tonnes.

The important uranium mining centres of India are: (i) Jharkhand–Bagjata, Banduhurang, Bhateen, Jaduguda, Mohuldeeh, Narwapur and Turamdeeh, (ii) Meghalaya–Keleng–Pindeng, Maothabah, Shahiyong, and Vakheen, (iii) Andhra Pradesh–Lambapur, Paddagtu and Tummalapalle.

Thorium: Thorium is derived from monazite. It is produced in Kerala, Jharkhand, Bihar, Tamil Nadu, and Rajasthan.

In addition to uranium and thorium, beryllium and lithium are also the atomic minerals found mainly in Jharkhand, Madhya Pradesh, and Rajasthan.

Salt: Salt is used mainly in chemical industry. Common salt (sodium chloride) is used as a food item. Salt is obtained from sea water, brine springs and salt pans in lakes. The main producers of salt are Gujarat, Maharashtra, Tamil Nadu, and Rajasthan. Gujarat coast accounts for about 50 per cent of the total salt production of India. Sambhar lake of Rajasthan contributes about 10 per cent of the total salt production of the country. In addition to this, rock salt is obtained from the Mandi area of Himachal Pradesh. The Mandi salt is hard and massive and has to be blasted.

India exports small quantities of salt to the neighbouring countries like Bangladesh, Bhutan, Indonesia, Japan, Maldive, Nepal, Singapore, South Korea, and Taiwan.

Problems of Mining Industry: India is rich in mineral resources. The mining industry is however, facing a number of problems. Some of the problems have been described briefly in the following:

1. **Ill-Defined Government Policy:** There is no well defined government policy about the prospecting, extraction and processing of mineral resources. A large number of lessees and contractors look upon mines as a quick money-making proposition and use unscientific techniques for the extraction of mineral ores.

2. **Obsolete Technology**: The technology used in mining is generally old and obsolete. Consequently, there is great wastage of mineral wealth.
3. **Inadequate Transport Facilities**: The minerals in the country are not uniformly distributed. For their transportation, the railways are used which are not very efficient, leading to bottlenecks, scarcity, and higher cost of transportation.
4. **Inadequate Exploration and Prospecting of Minerals**: In the absence of trained geologists, there are many areas in Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Madhya Pradesh, Maharshtra, Rajasthan, and Uttarakhand which have not been properly surveyed to explore the minerals.
5. **Inadequacy of Funds**: In the absence of inadequate funds, the infrastructure could not be developed in the areas of isolation and relative isolation where many of the most valuable minerals are found.
6. **Lack of Awareness about Conservation**: There is very little awareness about the exhaustible nature of the minerals and their conservation.
7. **Export of Mineral Ores:** The legacy of the colonial period is continuing and many of the basic minerals are exported to the developed countries of the world. Consequently, the minerals fetch low price in the international market.
8. **Strikes and Naxalites:** The mining industry is adversely affected by the frequent strikes of the miners and the Naxalites. The mineral rich parts of the country are unfortunately infested with Naxalites.
9. Mining is a hazardous industry in India. Hundreds of miners are killed every year. For example between 2008-2011, about 325 coal miners lost their life.

Conservation of Minerals: Minerals are the most valuable resources which are imperative for the economic development of the country. They are, however, non-renewable, and can not be replenished in short geological period. A judicious utilisation of mineral resources is necessary to meet the growing demand of our population and to provide the minerals for the future generations. Some of the steps which can go a long way in the conservation of mineral resources have been given in the following:

1. **Judicious Use**: The available minerals need to be utilised judiciously.
2. **Efficient Technology:** For the mining, processing and consumption, efficient technology is required for which continuous research is to be done.
3. **Alternatives to Minerals:** Research should be done to find the alternative to the mineral resources.
4. **Development of Infrastructure:** There should be emphasis on the development of roads and other infrastructure to obtain minerals from the areas of isolation and relative isolation.
5. **Location of Industries near the Mining Sites:** The mineral processing and metallurgical plants should be located near the mining centres to reduce the transportaion cost and problems.
6. **Recycling of Scrap**: The scrap should be recycled and people, especially the students, should be made aware about the exhaustible nature of minerals.
7. **Sustainable Mining**: There should be emphasis on sustainable mining. The miners should be properly trained in the new technology of mining.

The National New Mineral Policy, 1993: After liberalisation and globalisation, the mining industry has been opened to the private sector. The main objectives of the New Mineral Policy, 1993, are as under:

1. **Public Sector Mining:** Under the New Mineral Policy the government will continue the exploration and prospecting of the mineral wealth of the country, wherein special attention would be paid for the development of (i) strategic minerals, (ii) those minerals in which India has poor or just adequate resource base, and (iii) those minerals which are required for electronic and high-tech industries.
2. **Regular Supply of Minerals to Industries:** To develop mineral resources taking into account the national and strategic considerations, the strategy of development would entail (i) a regular supply of mineral raw material for industrial production, (ii) exploration and supply should address the present needs as well as future long-term needs of the country, (iii) adoption of efficient measures of processing of minerals and effective measures for conservation, and (iv) adoption of scientific methods of exploration.
3. **Foreign Investment**: The new mineral policy invites foreign equity and technology participation in exploration and mining of high value scarce minerals.
4. **Check on Adverse Environmental Effect**: In order to minimise the adverse effect of mining, social forestry will be an integral part of mining.
5. **To Promote Research**: To promote research and development in minerals, the new policy emphasises the promotion of research and development, technology upgradation, research in mining methods, development and processing.

Thus, the New Mineral Policy, 1993, makes a significant departure from the exclusive control of the Government on the exploration and exploitation of major minerals. The entry of private sector may aggrevate the situation by over-exploitation of minerals. Therefore, the government should take adequate and effective measures to overcome such a problem.

BIOTIC RESOURCES

The biotic resources include livestock (cattle, buffaloes, goat, and sheep rearing, pig rearing) fisheries, poultry farming. The livestock sector, which contributes about 27 per cent to the GDP from agriculture and allied activities, is of special importance in the arid and semi-arid regions.

Cattle

Animal husbandry and dairy development plays an important role in the rural economy and regional development. Cattle keeping supplements the income of rural households, especially that of marginal farmers and landless workers. It provides a subsidiary occupation in semi-urban areas, and more so for the people living in the hilly and drought prone areas. According to the All India Summary Reports of the 17th livestock Census released in July 2006, India possesses the largest livestock population in the world after Brazil. It accounts for about 56 per cent of the world's buffalo population and 14 per cent cattle population. It ranks first in respect of buffalo and second in respect of cattle population, second in goat population and third in respect of sheep in the world.

At the state level, Madhya Pradesh has the largest number of cattle in the country followed by Uttar Pradesh, Bihar, West Bengal, Odisha, and Karnataka. The percentage of cattle in the states of Sikkim, Arunachal Pradesh, Nagaland, Mizoram, and Meghalaya, is less than 0.2 per cent each. The density of cattle per 100 hectares of the gross cropped area in India is 112 which varies 365 in Manipur and 35 cattle in Haryana.

Cattle population in India can be classified into: (i) milch breed, (ii) draught breed, and (iii) mixed or general breed.

Milch Breeds: The cows which give relatively higher quantity of milk are known as milch breeds. The famous milch breeds in India are Deoni, Gir, Sahiwal, Sindhi, and Tharparkar. The Deoni breed is a native of the north-western parts of Andhra Pradesh which gives about 2000 kg of milk per lactation. The Gir breed is a native of Saurashtra which yields over 3000 kg of milk per lactation. The Sahiwal breed (formerly known as Montgomery in Pakistan) yields about 3000 to 4500 kg of milk per lactation period. The Sindhi breed is red in colour and produces about 5000 kg of milk per lactation.

Draught Breeds: The bullocks of the draught breeds are excellent draught animals. The main draught breeds in India are: (i) Nagori, and Bachaur, (ii) The Kathiawari, Malvi and Kherigarhi, (iii) the Mysore type characterised by prominent forehead with long pointed horns which are close together, e.g. Hallikar, Amritmahal, Kangyam, and Killari, and (iv) the small black and red coloured breeds of the Himalayan region known as Ponwar and Siri.

Dual Purpose Breed: The cows of these breeds give good quantity of milk and bullocks are good quality draught animals. Some such important breeds are Hariana (popular in Haryana, Uttar Pradesh, and Punjab), Ongole (belongs to Gantur and Nellore Districts of Andhra Pradesh), Gaolo (Nagpur and Wardha), Rath (Haryana and Mewat), Dangi (Nasik), Kridhna Valley and Nimari.

In order to improve the breed of the Indian cattle, seven central breeding farms have been established. Some of the exotic breeds yielding higher quantity of milk like Jersey, Holstein-Erie, Sain, Swiss brown, German Flekvich and Ayreshire have been introduced in the country which are becoming popular amongst the dairy farmers. The seven Central Breeding Centres are at Suratgarh (Rajasthan), Dhamrod (Gujarat), Alamadhi (Tamil Nadu), Chiplima, Similigude (Odisha), Andeshnagar (Uttar Pradesh), and Hessarghatta (Karnataka).

Buffaloes

Buffaloes are the major suppliers of milk to the Indian population. They constitute about 17 per cent of the total livestock of the country, but contribute about 55 per cent of the total milk production. In fact, the dairy industry of India is largely dependent on buffaloes.

As stated earlier, India has more than 56 per cent of the total buffaloes of the world. The better breeds of Indian buffalo are *Murrah, Bhadwari, Jaffarabadi, Saurti, Mehsana, Nagpuri, Rohtak, and Nili Ravi*. Murrah is an indigenous breed of Rohtak, Hissar and Gurgaon (Haryana). These buffaloes have short horn and massive body. The average lactation yield about 2000 kg. He buffaloes are suitable for draught and hard work. The Bhadawari with light colour is an indigenous breed of Etawah and Agra (UP). It yields about 1600 kg milk per lactation. (read White Revolution, Chapter 9).

The Indian cattle and buffaloes are weak in health and suffer from many diseases. In order to control livestock diseases "Livestock Health: Disease Control" has been implemented. The scheme was launched to eradicate the diseases of Rinderpest and Bovine Pleuro-pneumonia.

Goat Rearing

Goat provides milk, meat and hide. It is the main source of meat as about 35 per cent of the meat consumed in India is that of goat. In 1951, India had about 47 million goats which increased to

124 million in 2012. Bihar including Jharkhand has the largest number of goats followed by Rajasthan, West Bengal, Uttar Pradesh, Maharashtra and Madhya Pradesh.

Over 90 per cent of the goats are *desi*. The important breeds of goats are Angora or Himachali (known as Gaddi or Chamba breed of Himachal Pradesh and Jammu and Kashmir). This breed provides soft Pashmina, (wool) meat and hide. The Jamunapari is found between Yamuna and Chambal Valley. In Rajasthan, Gujarat and Madhya Pradesh, the main breeds of goats are Marwari, Mehsanwi, Kathiawari, and Zalwadi. Recently, a number of foreign breeds like Alpine, Nubian, Saanen and Angora (Turkey) have been used for cross-breeding with the indigenous breeds so as to improve the quantity of milk and meat production.

Sheep Rearing

India has about 4 per cent of the total population of sheep in the world. They are an important source of mutton, wool and hide in the country. There were about 39 million sheep in the country in 1951 which increased to 55 million in 2005–06. The total production of raw wool in 2005–06 was 45 thousand tonnes.

Sheep rearing in India is done mainly in Rajasthan (25%), followed by Andhra Pradesh (16%), Tamil Nadu (12%), Karnataka (11%), and Maharashtra (6%) of the total sheep of the country. The important breeds of sheep are *Lohi, Kutchi, Bikaneri, Marwari, Kathiawari, Jaisalmeri, Sonadi, Malpuri, Magra, Shekhawati, Pugal, Deccani, Nellori, Bellary, Gureji, Karna, Bakkarwal, Gaddi*. The Indian wool is, however, inferior to that of Australia and South Africa in quality and is called the coarse carpet wool. India exports wool to USA and UK.

The sheep breeds in India are generally poor. Efforts are being made to improve sheep breeds by crossing local breeds with the imported quality breeds like Australian Merino, Russian Merino, Spanish Merino, Cheviot, Leicester, and Lincoln (UK).

Poultry Farming

Poultry includes domestic fowls like chickens, ducks, geese, Japanese quil/emu, and turkey. These are kept to obtain meat, eggs, and feathers. Poultry farming requires small capital investment and provides good additional income and job opportunity to the rural population. There are over 300 million hens in the country which laid 54 billion eggs in 2009–10.

The poultry sector, with a total value of output exceeding Rs.15,000 crore and providing direct and indirect employment to over three million people, produced around 1.9 million tonnes of chicken meat in 2005.

Andhra Pradesh has the largest number of poultry population followed by Bihar, West Bengal, Tamil Nadu, Assam, Maharashtra, Karnataka, Kerala, Odisha, Madhya Pradesh, and Uttar Pradesh. Poultry farms have been developed around almost all the important urban centres like Mumbai, Kolkata, Delhi, Chandigarh, Chennai, Hyderabad, Pune, Bangalore, Nagpur, Bhubaneswar, Shimla, and Ajmer.

The Indian fowls belong to two categories: (i) Desi, and (ii) exotic or imported. The Desi breed include Chittagong, Punjabi, Brown, Chagas, Lolab, Naked-neck, Titre, Bursa, Tillicherry, etc. The imported breeds include White Leghorn, Rhode Island Red, Black Minorca, Plymouth Rock, New Hampshire, Light Sussex, Brown Leghorn and Australorp, etc.

The Central Poultry Farms are located at Mumbai, Hassarghatta (near Bangalore), Chandigarh and Bhubaneswar. These farms are established to improve poultry breed to produce more eggs.

Export of products such as live poultry, eggs, hatching eggs, frozen eggs, egg-powder, and poultry meat are made to Bangladesh, Sri Lanka, South West Asian countries, Japan, Denmark, Poland, USA, and Angola.

The bird influenza has created numerous problems for poultry development in India. The first outbreak was in 2006 in a small area in Maharashtra. The second outbreak was also reported from Maharashtra a few months later. In order to overcome this problem, an active surveillance programme is being carried out all over the country focusing on an early detection of avian influenza. The Government of India maintains a strategic reserve of poultry vaccine. India has a fully equipped Bio-Security Level 3 laboratory at Bhopal.

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