TABLE 22.12. Distribution of Bajra in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million Tonnes	%age of all India	(kg/hectare)
1. Rajasthan	3.99	55.42	3.88	44.39	972
2. Uttar Pradesh	0.90	12.50	1.76	20.14	1956
3. Gujarat	0.62	8.61	1.07	12.24	1726
4. Haryana	0.41	5.69	0.79	9.04	1927
5. Maharashtra	0.62	8.61	0.42	4.81	677
6. Karnataka	0.31	4.31	0.32	3.66	1032
7. Madhya Pradesh	0.19	2.64	0.30	3.43	1579
8. Andhra Pradesh	0.07	0.97	0.11	1.26	1571
9. Tamil Nadu	0.05	0.69	0.07	0.8	1400
10. Jammu & Kashmir	0.02	0.28	0.01	0.11	500
Others	0.02	0.28	0.01	0.11	@
All India	**7.20**	**100.00**	**8.74**	**100.00**	**1214**

@ Since area/production is low in individual states, yield rate is not worked out.
Source : Agricultural Statistics at a glance, 2013 p. 80.

decrease in production in this state and partly due to increase in production in other states. In Maharashtra, bajra is mainly grown in the central plateau having poor soils and dry climate. Nashik, Dhule, Satara, Pune, Sangli, Aurangabad, Solapur, Jalgaon and Ahmednagar are the main producing districts. Among the other producers are Madhya Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh, Telangana and Jammu and Kashmir.

RAGI

Ragi is another important millet mainly grown in drier parts of south India with some parts of north India also contributing a small quantity. It requires 20°-30°C temperature and 50-100 cm rainfall. It is raised on red, light black and sandy loams as well as on well drained alluvial loams. It is a rainfed kharif crop which is sown between May and August and harvested between September and January.

Table 22.13 shows that there had been varying trends in area, production and yield of ragi in India. These variations are the result of varying weather conditions and choicer of farmers regarding selection of crops.

The total production of Ragi was 23.54 lakh tonnes in 2005. **Karnataka** is the largest producer accounting for 17.24 lakh tonnes (73.23 per cent) from 9.38 lakh hectares (61 per cent). Bengaluru, Kolar, Hassan, Tumkur, Chitradurga and Mysore districts account for over 80 per cent production of Karnataka. **Uttarakhand** is the second largest producer but lags far behind Karnataka with only 1.74

TABLE 22.13. Area, Production and Yield of Ragi in India

Year	1990-91	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Area (thousand hectares)	2171	1759	1647	1405	1666	1553	1534
Production (thousand tonnes)	8962	2732	2375	1316	1966	2432	2354
Yield (quintals per hectare)	10.8	15.5	14.4	9.3	11.8	15.7	15.3

Source : Statistical Abstract or India 2007, pp. 110, 116, 122.

lakh tonnes (7.4 per cent). Tamil Nadu is the third largest producer with 1.33 lakh tonnes of ragi production in 2005-06. Dharmpuri, Salem, Coimbatore, Ramnathpuram, Madurai, and Nilgiri districts are the main producers. **Maharashtra** (1.32 lakh tonnes), Andhra Pradesh (0.79 lakh tonnes) are some other important producers.

BARLEY

Barley, like millets, is considered as an inferior grain. Besides food, it is used for manufacturing beer and whisky.

Conditions of Growth

It does not tolerate high heat and high humidity and thrives well in areas where the temperature is 10°-15°C for about three months in a year and the rainfall varies from 75 cm to 100 cm. Light clay and alluvial soils are best suited for its cultivation. It is grown as a rabi crop in the Great Plains and valleys of the western Himalayas. It can be grown upto an altitude of 1,300 metres as in Uttarakhand.

Production and Distribution

Over the years, fluctuating trends have been observed in the production of barley but the production has definitely declined by over 56 per cent in four and a half decades from 28.19 lakh tonnes in 1960-61 to 12.21 lakh tonnes in 2005-06. More conspicuous is the decline in area under barley which had come down from 32.05 lakh hectares in 1960-61 to a meagre 6.46 lakh hectares in 2005-06. However, the yield has recorded two and a half times increase during the same period. It was just 8.8 quintals/hectare in 1960-61 and rose to 19.7 quintals/hectare in 2005-06. The probable cause of decline in area and production is more importance being given to main food crops, particularly to wheat. This is not good for balanced growth of agriculture and must be checked.

Rajasthan is the largest producer accounting for over 40 per cent production of the country. The major part of the production comes from Pali, Tonk, Sawai Madhopur, Alwar, Bharatpur, Sikar, Jaipur, Udaipur, Ajmer, Bhilwara, Ganganagar and Hanumangarh districts. **Uttar Pradesh** is the second largest producer contributing 33.8 per cent of the total India. Aligarh, Agra, Bulandshahar, Mathura, Fatehpur, Allahabad, Varanasi, Mirzapur, Jaunpur, Ghazipur, Gorakhpur, Ballia, Partapgarh, Azamgarh etc. are the main producing districts.

Thus nearly three fourth barley comes from just two states. Some barley is also produced in **Madhya Pradesh** (100 thousand tonnes). Haryana (76 thousand tonnes) Punjab (63 thousand tonnes), **Chhattisgarh** (19 thousand tonnes), Uttarakhand (18 thousand tonnes), Himachal Pradesh (18 thousand tonnes), Bihar (18 thousand tonnes) and West Bengal.

PULSES

Pulses include a number of crops which are mostly leguminous and provide much needed vegetable proteins to a largely vegetarian population of India. They serve as an excellent forage and grain concentrates in the feed of cattle. Pulses have the capacity to fix atmospheric nitrogen in the soil and are normally rotated with other crops to maintain or restore soil fertility. Though gram and *tur* (arhar) are the more important pulses, several other pulses such as *urd* (black gram), *mung* (green gram), *masur* (lentil), *kulthi* (horse gram), *matar* (peas), *khesri* and *moth* are also grown.

GRAM

Gram is the most important of all the pulses and accounts for 37 per cent of the production and 28.28 per cent of the total area of pulses in India. It can be grown in a wide range of climatic conditions but it prefers mild cool and comparatively dry climate with 20°-25°C temperature and 40-50 cm rainfall. It grows well on loamy soils. It is a rabi crop, which is sown between September and November and is harvested between February and April. It is cultivated as pure or mixed with wheat, barley, linseed or mustard. Mixed cropping helps to check the gram blight to some extent.

Production

Like other food crops of second order, gram has also suffered a lot at the hands of wheat. The area under gram cultivation fell from a peak of 10.33 million hectares in 1959-60 to an extremely low of 5.19 million hectares in 2000-01. Similarly production of gram fell from 7.62 million tonnes in 1958-59 to a very low of 3.63 million tonnes in 1987-88. However,

some recovery has been made both with respect to area and production of gram during the last one decade although varying trends have been observed in area as well as production of gram. But the yield per hectare has recorded a significant increase from 482 kg in 1950-51 to 744 kg in 2000-01 and 6021 kg in 2012-13 (**Table 22.14**).

Distribution

Although gram is cultivated in several parts of India, most of the gram comes from Madhya Pradesh, Rajasthan and Maharashtra. These three states account for more than two-thirds of the total gram production of the country (**Table 22.15**).

Madhya Pradesh is the largest producer with 3.55 million tonnes (40%) to its credit. Vidisha, Bhind, Morena, Chhatarpur, Jabalpur, Narsingpur, Dhar, Hoshangabad, Raisen, Gwalior, Patlam, Ujjain, Guna, Sagar, Shivpuri and Dalia are significant producers. Next to Madhya Pradesh is **Rajasthan** producing 1.27 million tonnes accounting for over 14 per cent of India's production. Gananagar, Alwar, Bharatpur, Jaipur, Sawai Madhopur, Udaipur, Banswara, Jaiselmer, Kota, Tonk, Churu, Jhunjhuna and Ajmer are the main producing districts. **Maharashtra** is the third largest producer and produces about one million tonnes amounting to about twelve per cent of India's production. The bulk of gram comes from Usmanabad, Aurangabad, Solapur, Parbhani, Ahmednagar, Beed, Nandel and Nasik districts. In **Andhra Pradesh**, most of the production comes from the Rayalseema region. **Uttar Pradesh** is the fifth largest producer of gram in the country. The main producing districts are Banda, Hamirpur, Jalaun, Jhansi, Kanpur, Allahabad, Fatehpur, Sitapur, Barabanki, Agra, Lalitpur and Sultanpur. The other important producing states are Karnataka, Gujarat, Bihar and Chhattisgarh. Gram in small quantities is also produced in Haryana, Odisha and West Bengal.

TABLE 22.14. Area, Production and Yield of Gram in India

Year	1950 -51	1960 -61	1970 -71	1980 -81	1987 -88	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13
Area (Million hectares)	7.57	9.28	7.84	6.58	5.77	5.19	6.93	7.49	7.54	7.89	8.17	9.19	8.30	8.70
Production (Million tonnes)	3.65	6.25	5.20	4.33	3.63	3.86	5.60	6.33	5.75	7.06	7.48	8.22	7.58	8.88
Yield (kg/hectare)	482	674	663	657	629	744	808	845	762	895	915	895	912	1021

Source : Agricultural Statistics at a glance 2013, pp. 87-88.

TABLE 22.15. Distribution of Gram in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million Tonnes	%age of all India	(kg/hectare)
1. Madhya Pradesh	3.13	35.98	3.55	39.98	1134
2. Rajasthan	1.25	14.37	1.27	14.30	1016
3. Maharashtra	1.25	14.37	1.06	11.94	848
4. Andhra Pradesh	0.68	7.82	0.76	8.56	1118
5. Uttar Pradesh	0.60	6.90	0.73	8.22	1217
6. Karnataka	0.03	0.34	0.65	7.32	2166
7. Chattisgarh	0.27	3.10	0.29	3.27	1074
8. Gujarat	0.17	1.95	0.20	2.25	1176
9. Bihar	0.06	0.69	0.09	1.01	1500
10. Haryana	0.05	0.57	0.05	0.56	1000
11. Odisha	0.04	0.46	0.03	0.34	750
12. West Bengal	0.03	0.34	0.03	0.34	1000
Others	1.14	13.10	0.17	1.91	@
All India	**8.70**	**100**	**8.88**	**100**	**1021**

@ Since area/production is low in individual states, yield rate is not worked out.

Source : Agricultural Statistics at a glance, 2013, p. 89.

TUR or ARHAR (Pigeon Pea or Red Gram)

Tur is the second most important pulse of India next to gram. It is chiefly grown as a kharif crop but in areas of mild winters it is grown as a rabi crop also. It is grown as a dry crop mixed with other kharif crops like jowar, bajra, ragi, maize, cotton, groundnut, etc. and is seldom grown as a single crop. Its conditions of growth are more or less similar to those of other pulses and millets.

Production

Table 22.16 shows that there have been large scale temporal variations with respect to area, production and yields of tur.

TABLE 22.16. Area, Production and Yield of Tur in India

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13
Area (Million hectares)	2.18	2.43	2.66	2.84	3.59	3.63	3.58	3.56	3.73	3.38	3.47	4.37	4.01	3.81
Production (Million tonnes)	1.72	2.07	1.88	1.96	2.41	2.25	2.74	2.31	3.08	2.27	2.46	2.86	2.65	3.07
Yield (kg/hectare)	788	849	709	689	673	618	765	650	826	671	711	655	656	806

Source : Agricultural Statistics at a glance, 2013, p. 90, 91.

TABLE 22.17. Production of Tur in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million Tonnes	%age of all India	(kg/hectare)
1. Maharashtra	1.08	28.35	0.91	29.64	843
2. Madhya Pradesh	0.53	13.91	0.4	13.03	755
3. Karnataka	0.67	17.59	0.37	12.05	552
4. Uttar Pradesh	0.31	8.14	0.37	12.05	1194
5. Gujarat	0.23	6.04	0.27	8.79	1174
6. Andhra Pradesh	0.48	12.60	0.25	8.14	521
7. Jharkhand	0.19	4.99	0.20	6.51	1053
8. Odisha	0.14	3.67	0.13	4.23	929
9. Bihar	0.03	0.79	0.05	1.63	1667
10. Tamil Nadu	0.05	1.31	0.04	1.30	800
Others	0.10	2.62	0.08	2.61	@
All India	**3.81**	**100.00**	**3.07**	**100.00**	**806**

@ Since area/production is low in individual states, yield rate is not worked out.

Source : Agricultural Statistics at a glance, 2013, p. 92.

Distribution

A look at **table 22.17** reveals that **Maharashtra** is the largest producer of tur in India with over 29 per cent production from over 28 per cent area under tur. Most of production comes from Amrawati, Wardha, Akola, Yavatmal, Beed, Nagpur, Usmanabad, and Parbani districts. **Madhya Pradesh** is the second largest producer where major part of production comes from Hoshangabad, Chhindwara, Bebul, East Nimar, Dewas, Sidhi, Narsimhapur, and Bhind districts. *Karnataka* with about 12 per cent of the production is the third largest producer. Gulbarga, Bellary and Bidar districts of the North Moidan are the main producers. In **Uttar Pradesh**, Varanasi, Jhansi, Allahabad and Lucknow are the main producing districts. The other tur producing states include Gujarat, Andhra Pradesh, Jharkhand, Odisha, Bihar and Tamil Nadu. Bihar has the distinction of giving highest yield of 1667 kg/hectare which is over two times the national average of 806 kg/hectare.

CASH CROPS

Cash crops are those crops which are grown for sale in the market either in raw form or in semi-processed form. Thus cash crops have special characteristic of earning cash for the farmer. Prominent among the cash crops are cotton, jute, sugarcane, tobacco and oilseeds. These crops play a significant role in the economy of the country. This is evident from the fact that they occupy only 15 per cent of the total cropped area of the country but account for over 40 per cent of the agricultural production by value. Besides they provide raw materials to a large number of industries.

COTTON

Cotton is the most important fibre crop not only of India but of the entire world. It provides the basic raw material (*cotton fibre*) to cotton textile industry. Its seed (*binola*) is used in vanaspati industry and can also be used as part of fodder for milch cattle to get better milk.

Conditions of Growth

Cotton is the crop of tropical and sub-tropical areas and requires uniformly high temperature varying between 21°C and 30°C. The growth of cotton is retarded when the temperature falls below 20°C. Frost is *enemy number one of the cotton plant* and it is grown in areas having at least 210 frost free days in a year. The modest requirement of water can be met by an average annual rainfall of 50-100 cm. However, it is successfully grown in areas of lesser rainfall with the help of irrigation. About one-third of the total area under cotton cultivation is irrigated. About 80 per cent of the total irrigated area under cotton is in Punjab, Haryana, Gujarat and Rajasthan. Moist weather and heavy rainfall at the time of boll-opening and picking are detrimental to cotton as the plant becomes vulnerable to pests and diseases. High amount of rainfall in beginning and sunny and dry weather at ripening time are very useful for a good crop.

Cotton is a kharif crop which requires 6 to 8 months to mature. Its time of sowing and harvesting differs in different parts of the country depending upon the climatic conditions. In Punjab and Haryana, it is sown in April-May and is harvested in December-January, that is before the winter frost can damage the crop. In the peninsular part of India, it is sown upto October and harvested between January and May because there is no danger of winter frost in these areas. In Tamil Nadu, it is grown both as a kharif and as a rabi crop. Here the rainfall occurs after September and cotton is sown in October. The irrigated crop is sown in January-February. Most of the crop is grown mixed with other kharif crops such as maize, jowar, ragi, sesamum, castor, groundnut and some vegetables.

Cotton cultivation is closely related to deep black soils (*regur*) of the Deccan Plateau and the Malwa Plateau and those of Gujarat. It also grows well in alluvial soils of the Satluj-Ganga Plain and red and laterite soils of the peninsular region. Cotton quickly exhausts the fertility of soil. Therefore, regular application of manures and fertilizers to the soils is very necessary.

Picking is a crucial period from the labour point of view. Since picking of cotton is not yet mechanized, a lot of cheap and efficient labour is required at this time. Normally the picking season is spread over a period of about three months.

Types of Cotton

Three broad types of cotton are generally recognised on the basis of the length, strength and structure of its fibre.

TABLE 22.18. Area, Production and Yield of Cotton in India

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13
Area (Million hectares)	5.88	7.61	7.61	7.82	7.44	8.53	8.68	9.14	9.41	9.41	10.13	11.24	12.18	11.98
Production (Million bales*)	3.04	5.60	4.56	7.01	9.84	9.52	18.50	22.63	25.88	22.28	24.02	33.00	35.20	34.00
Yield (kg/hectare)	88	125	122	152	225	190	362	421	467	403	403	499	491	482

*1 bale = 170 kg.

Source : Agricultural Statistics at a glance, 2013, pp. 111-12.

1. Long staple cotton. It has the longest fibre whose length varies from 24 to 27 mm. The fibre is long, fine and lustrous. It is used for making fine and superior quality cloth. Obviously, it fetches the best price. There has been rapid progress in the production of long staple cotton since Independence. About half of the total cotton produced in India is long staple. It is largely grown in Punjab, Haryana, Maharashtra, Tamil Nadu, Madhya Pradesh, Gujarat and Andhra Pradesh.

2. Medium staple cotton. The length of its fibre is between 20 mm and 24 mm. About 44 per cent of the total cotton production in India is of medium staple. Rajasthan, Punjab, Tamil Nadu, Madhya Pradesh, Uttar Pradesh, Karnataka and Maharashtra are its main producers.

3. Short staple cotton. This is inferior cotton with fibre less than 20 mm long. It is used for manufacturing inferior cloth and fetches less price. About 6 per cent of the total production is of short staple cotton. U.P., Andhra Pradesh, Rajasthan, Haryana and Punjab are its main producers.

Production

India has the largest area under cotton cultivation in the world though she is the world's third largest producer of cotton after China and the U.S.A. Currently it is grown over 8.6 per cent of the net sown area. **Table 22.18** shows the trends in the production of cotton in India.

Bt Cotton

Bt stands for *Bacillus thuringiensis*, the bacterium whose toxin is produced by Bt cotton after genetic alteration. The first Bt protected cotton crops were tested in the fields of U.S.A. and it entered in U.S. cultivation in 1995. China welcomed Bt cotton in 1997. Later 13 countries, including India, followed the cultivation of Bt cotton. In India, it was released for commercial cultivation in 2002. The initial field trials of Bt cotton showed extremely encouraging results as the yield of Bt cotton was *80 per cent more than that of non-Bt variety although it required three times less spraying and 70 per cent less insecticide.* The area under cotton crop increased sharply by about 50 per cent from 8.53 million hectares in 2000-01 to 12.18 million hectares in 2011-12 and the production also registered more than three times increase from 9.52 million bales (1 bale = 170 kg) in 2000-01 to 35.20 million bales in 2011-12. A number of studies conducted on Bt cotton before and after commercialization have shown the following benefits :

(*i*) Higher cotton yield owing to effective control of bollworms.

(*ii*) Drastic reduction in application of chemical insecticides for bollworm control.

(*iii*) Higher profit to farmers.

(*iv*) Conservation of biological control agents and other beneficial organisms.

The area under Bt cotton raised from a minimal of 1 per cent in 2003-04 to a staggering 90 per cent in 2011-12 (**Table 22.19**). In spite of large area under Bt cotton, the yields have not registered any increase worth the name. This shows that the new Bt cotton is loosing its sheen. According to K.R. Kranthi, Director, Central Cotton Research Institute (CICR), "Although the GM variety, officially allowed in 2002, sharply raised yields initially, productivity is now projected to decline and signs of diminishing returns

TABLE 22.19. Area under Bt Cotton

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Percentage of area under Bt	0	1	6	18	41	62	84	85	85	90

Source : Cotton Corporation of India.

are visible now." In fact Bt toxin is a narrow spectrum bio-insecticide as it controls only bollworm. Cotton attracts over 130 different species of pests. The biodiversity of cotton pests varies from insects like ball weevil, grey weevil, cotton jassid, cotton aphids, cotton thrip to Nematodes like root-rust.

The above mentioned situation needs to be improved for which better technology (seeds, fertilizers, pesticides, insecticides and irrigation) is required. Maharashtra has the largest area of 20 lakh hectares under Bt cotton, followed by Andhra Pradesh (7.6 lakh hectares), Gujarat (3.3 lakh hectares) and Madhya Pradesh (3.1 lakh hectares). All these states are in South India : In North India Punjab and Haryana have 2.8 lakh hectares and 0.42 lakh hectares respectively under Bt cotton. The biggest concern about large scale adoption of Bt cotton in India is that the bollworm (a serious pest disease of cotton) may develop resistance to this transgenic crop as has happened in some parts of China. It is worth noting that almost 65 per cent of the area under cotton is rainfed with erratic and poorly distributed rains during the cropping season. It is subjected to severe attack of pests and diseases.

Distribution

India has the sole distinction of growing all the three cultivated species of cotton and their intra- and inter-specific hybrids. In India, cotton is grown in three distinct agro-ecological zones, *viz.*, Northern (Punjab, Haryana and Rajasthan), Central (Gujarat, Maharashtra and Madhya Pradesh) and Southern zone (Andhra Pradesh, Tamil Nadu and Karnataka).

Table 22.20 shows the statewise distribution of cotton in India.

1. Gujarat. Accounting for over 25 per cent of the total production and nearly 21 per cent of the cotton area of the country, Gujarat is the largest cotton producing state of India. The average yield is 594 kg/hectare. With 'black cotton soil' 1.5 metre deep in some parts and with 80-100 cm annual rainfall Gujarat provides favourable conditions for cotton cultivation. Two-thirds of the production comes from the Gujarat plains including Bharuch, Surendernagar, Vadodra and Ahmedabad districts. Mahesana, Kheda, Sabarkantha, Surat, Amreli and Panchmahals are other major producers.

2. Maharashtra. Maharashtra is the second largest producer and produces over 22 per cent of the total cotton production of India. Maharashtra is a traditional producer of cotton. The lava soil of deccan plateau is world renowned for cotton production and is popularly known as the *black cotton soil*. Over 80 per cent of the production comes from Khandesh, Vidarbha and Marathwada regions comprising the districts of Yavatmal, Nanded, Amravati, Parbhani, Wardha, Jalgaon, Akola, Buldhana, Nagpur, Dhule, etc. However, Maharashtra suffers from low productivity as this state gives the lowest yield of 313 bales/hectare among the cotton producing states of India.

3. Andhra Pradesh. Andhra Pradesh accounts for about 21 per cent of production and over 20 per cent of hectarage of India. Two-thirds of the production of Andhra Pradesh comes from two districts,

DESI BT COTTON

The Genetic Engineering Approval Committee (GEAC) has approved a new Bt cotton variety for commercial planting, making it India's first genetically modified (GM) to be developed by the public sector. The new cotton variety called *Bikaneri Narma* was developed by the Central Institute of Cotton Research (CICR), Nagpur and the University of Agricultural Sciences in Dharwar (Karnataka). The variety contains the gene for the Bt cry 1 AC protein and has been approved by GEAC for release in the North, Central and South Cotton Growing Zones of the country. Farmers have been using it since 2009. It is too early to draw any conclusion about the impact of desi Bt cotton.

TABLE 22.20. Statewise Distribution of Cotton in India (2012-13)

States	Area		Production		Yield (kg/hectare)
	Million hectares	%age of all India	Million balls	%age of all India	
1. Gujarat	2.50	20.87	8.73	25.68	594
2. Maharashtra	4.15	34.64	7.65	22.50	313
3. Andhra Pradesh	2.40	20.03	7.35	21.62	521
4. Haryana	0.61	5.09	2.50	7.35	697
5. Madhya Pradesh	0.61	5.09	2.20	6.47	613
6. Punjab	0.48	4.01	2.00	5.88	708
7. Rajasthan	0.45	3.76	1.30	3.82	491
8. Karnataka	0.49	4.09	1.20	3.53	416
9. Tamil Nadu	0.13	1.09	0.50	1.47	654
Others	0.16	1.34	0.57	1.68	@
All India	**11.98**	**100.00**	**34.00**	**100.00**	**482**

@ Since area/production is low in individual states, yield rate is not worked out.

* 1 cotton bale = 170 kg.

Source : Agricultural Statistics at a glance, 2013, p. 113.

namely Guntur and Prakasam. Kurnool and Anantapur contribute the rest.

4. Haryana. Accounting for 7.35 per cent production and 5.09 per cent of hectarage, Haryana is the fourth largest producer of cotton in India. In the year 2012-13, Haryana produced 2.5 million bales. About 80 per cent of the production comes from Hissar, Sirsa and Fatehabad districts which are contiguous to the major cotton producing districts of Punjab. Like Punjab, most of the production is in the form of the American long staple varieties. Bhiwani, Jind and Rohtak and Ambala are other producing districts.

5. Madhya Pradesh. More than 80 per cent of the production comes from Malwa where there are vast tracts of lava soil. East Nimar, West Nimar, Ujjain, Shajapur, Dewas, Dhar, Ratlam, Rajgarh, Indore, and Bhopal are the main producers.

6. Punjab. Punjab has slipped from first position in 1990-91 to sixth position in 2012-13 as a producer of cotton in India. This state has the distinction of giving the highest yield of 708 kg/hectare (2012-13). Punjab has also the distinction of producing some of the best qualities of cotton in India. All this has been made possible due to fertile alluvial soils, a close network of irrigation facilities, heavy dose of fertilizers and pesticides and above all the enterprising spirit of the farmers. Most of the cotton production comes from the Malwa region of the state. This region contributes nearly 95 per cent of Punjab's cotton. Cotton is known as "white gold" in this region. Bhatinda, Faridkot, Firozepur and Sangrur are the major producing districts and account for over three fourths of Punjab's total production of cotton. Ludhiana, Muktsar, Moga, Mansa and Fatehgarh Sahib are other cotton producing districts.

7. Rajasthan. Rajasthan accounts for about 3.82 per cent of the production and 3.76 per cent of the area of the country. The state has the low yield of only 491 kg/hectare. Ganganagar is the most important cotton producing district of Rajasthan and accounts for over 80 per cent of the state's production. This district is contiguous to the cotton producing areas of Punjab and Haryana and enjoys the same advantages. The remaining cotton of Rajasthan comes from Bhilwara, Ajmer, Chittaurgarh, Jhalawar, Pali and Hanumangarh.

8. Karnataka. This state produces 3.53 per cent cotton of India from 4.09 per cent of India's area under cotton cultivation. The North Karnataka plateau

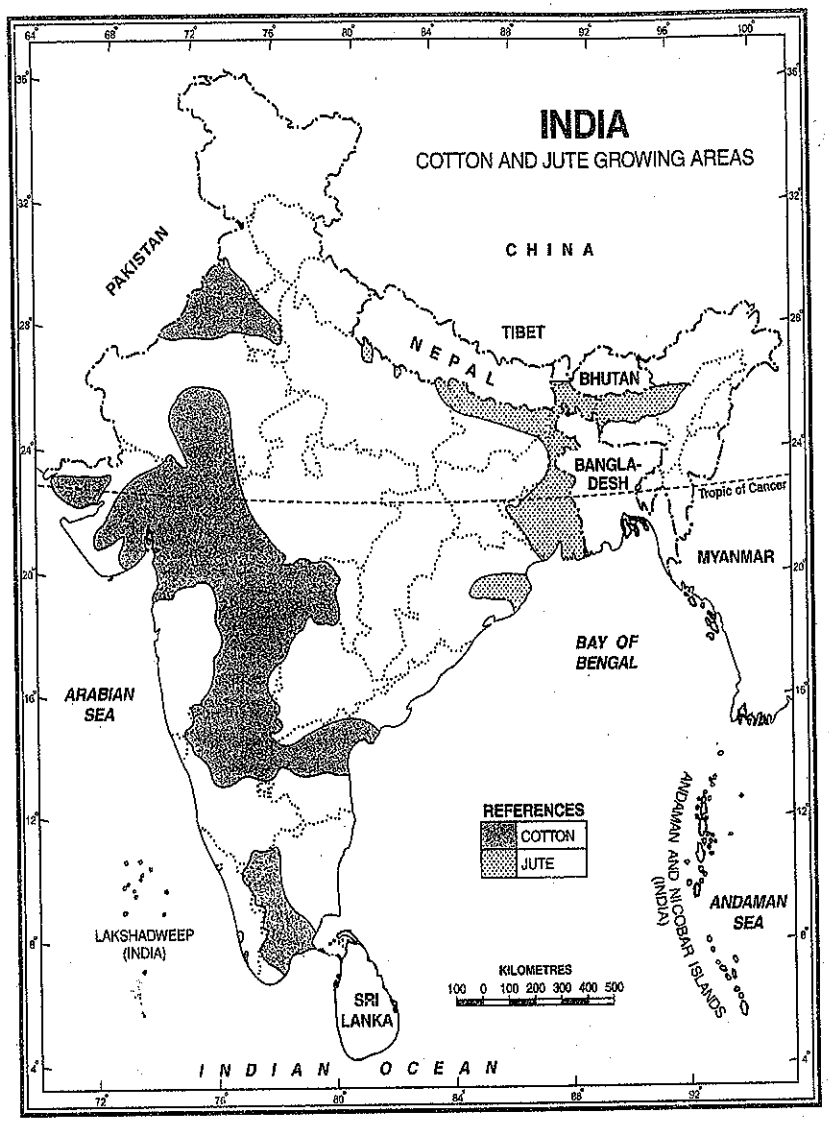

FIG. 22.3. India : Fibre Crops (Cotton & Jute)

is the main area of cotton cultivation. Dharwad, Raichur, Bellary and Gulbarga are the main producing districts.

9. Tamil Nadu. Tamil Nadu contributes about 1.47 per cent of the total production with about 1.09 per cent of the total area of the country. Coimbatore, Salem, Madurai, Tiruchirapalli, Ramnathapuram, Vellore, Chengalpattu and Tirunelveli are the main producing districts.

Uttar Pradesh, Kerala, Odisha, Meghalaya and Mizoram also produce cotton in small quantities.

Trade

India is an exporter as well as importer of cotton.

TABLE 22.21. India : Imports and exports of Cotton, Raw including waste ('000 tonnes)

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Imports	233.85	252.90	192.18	98.75	81.48	136.48	211.69	171.42	58.41	77.42	231.01
Exports	11.75	179.61	86.64	614.80	1162.22	1557.59	457.56	1357.99	1885.77	2003.58	2014.82

Source : Agricultural Statistics at a glance, 2012, pp. 245-49 and 2013, pp. 243-47.

India exports inferior quality cotton mainly to U.K., where it is mixed with superior quality cotton. India has been a big importer of superior quality long staple cotton mainly from the USA, Russia, UAR, Sudan and Kenya. With the increase in domestic production of superior quality cotton, our imports have come down and exports have increased considerably (Table 22.21) India has achieved near self-sufficiency in the production of superior quality cotton.

Considering the major provisions of World Trade Organisation (WTO) *vis-a-vis* India's position, the points that emerge to be of immediate concern in enhancing the productivity and quality of Indian cotton and making it competitive globally are : (*i*) bringing down the cost of cultivation and enhancing its productivity and quality, (*ii*) rendering our cotton globally attractive, (*iii*) keeping Indian cotton free of trash content.

JUTE

Next to cotton, jute is the second important fibre crop of India. Jute is in great demand because of the cheapness, softness, strength, length, lustre and uniformity of its fibre. It is used for manufacturing a large variety of articles such as gunny bags, hessian, ropes, strings, carpets, rugs and clothes, tarpaulins, upholstery and decoration pieces.

Conditions of Growth

Jute is the crop of hot and humid climate. It requires high temperature varying from 24°C to 35°C and heavy rainfall of 120 to 150 cm with 80 to 90 per cent relative humidity during the period of its growth. Small amount of pre-monsoon rainfall varying from 25 cm to 55 cm is very useful because it helps in the proper growth of the plant till the arrival of the proper monsoon. Incessant and untimely rainfall as well as prolonged droughts are detrimental to this crop. Rainfall between 2.5 to 7.5 cm in a month, during the sowing period, is considered to be sufficient. Occasional showers varying from 2 to 3 cm at intervals of a week's time during the growing period are very useful. Large quantity of water is required not only for growing the jute crop but also for processing the fibre after the crop is harvested. Light sandy or clayey loams are considered to be best suited soils for jute. Since jute rapidly exhausts the fertility of soil, it is necessary that the soil is replenished annually by the silt-laden flood water of the rivers. Large supply of cheap labour is also necessary for growing and processing the jute fibre.

Method of Cultivating and Processing of Jute

Jute is generally sown in February on lowlands and in March-May on uplands. The crop takes 8-10 months to mature but different varieties take different time to mature. The harvesting period generally starts in July and continues till October. The plants are cut to the ground and tied into bundles. Sheafs of jute stocks are then immersed in flood water or ponds or stagnant water for about 2 to 3 weeks for retting. High temperature of water quickens the process of retting. After retting is complete, the bark is peeled from the plant and fibre is removed. After this, stripping, rinsing, washing and cleaning is done and the fibre is dried in the sun and pressed into bales. All this process is to be done by human hand for which availability of plenty of labour at cheap rates is very essential. Luckily, this labour is readily available because jute is cultivated in areas of high population density.

Production

India suffered a great setback in the production of jute as a result of partition of the country in 1947 because about 75 per cent of the jute producing areas

went to Bangla Desh (East Pakistan at that time). Fortunately, most of the jute mills remained in India. Strenuous efforts were made to increase production and area of jute, immediately after partition to feed our starving jute mills in the wake of short supply of raw jute.

Table 22.22 shows that there had been rapid increase in area, production and yield of jute during three decades between 1950-51 and 1980-81 after which varying trends in almost all the three aspects (area, production and yield) have been observed. This is perhaps due to changes in weather conditions and pressure on land for other crops like rice. In fact there is tough competition for land in the delta region.

The significant role played by jute in the country's economy can be assessed from the fact that more than 4 million farm families are involved in jute farming and majority of them belong to small and marginal categories. Cultivation of jute generates employment (seasonal) of more than 10 million mandays per season. Besides 0.5 million people are involved in raw jute and finished goods trading and ancillary activities. Currently India accounts for about 56 per cent of world jute production as compared to only 25 per cent produced by Bangladesh. Research and development work carried by the agricultural scientists during the last few years has not only resulted in increasing yield of the fibre but also in improvement of the fibre quality and shortening of cultivation period. Investigations reveal that the crop pattern jute-paddy-potato is more profitable for the farmers than say paddy-potato-sesame.

Distribution

Table 22.23 shows that over 99 per cent of the total jute of India is produced in just fives states of West Bengal, Bihar, Assam, Andhra Pradesh and Odisha.

1. West Bengal. West Bengal is the undisputed king of jute production in India accounting for about three-fourth of the production and nearly two-thirds of the area under jute. Here hot and humid climate and alluvial, loamy soil coupled with cheap abundant labour provide conditions *par excellence* for the growth of jute. Almost all parts of the state are producing some jute but its cultivation decreases in the north sub-Himalayan region, towards the south in the Ganga delta where land is too low for jute and towards the west where the rocky ground of the Deccan plateau is more marked than the Ganga alluvium. However, major part of the production comes from Nadia, Murshidabad, 24 Parganas, Koch Bihar, Jalpaiguri, Hugli, Dakshin Dinajpur, Bardhaman, Maldah, Paschim Medinapur and Purba Medinapur districts. The entire jute production is consumed in the jute mills located in the Hugli basin. In 2012-13, West Bengal produced 8.31 million bales (73.54% of India) of jute from 0.58 million hectares (66.67%) of India giving highest yield of 2579 kg/ha.

2. Bihar. Bihar is the second largest producer but lagging far behind West Bengal in the production of jute accounting only for about 18.5 per cent of the production and over 17 per cent of the area of the country under jute. Purnea is the largest producing district accounting for 60 per cent of Bihar's production. Katihar, Saharsa and Darbhanga are the other producing districts.

3. Assam. With about 5.13 per cent of the production and 8.05 per cent of the area of the country, Assam is the third largest jute producing state of India. The main concentration is in the Brahmaputra and Surma valleys. Goalpara, Kamrup, Nowgong, Darrang and Sibsagar are the main producing districts.

TABLE 22.22. All India, Area, Production and Field of Jute and Meslin

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13
Area (Million hectares)	0.57	0.90	1.08	1.30	0.91	1.02	0.90	0.94	0.96	0.90	0.91	0.87	0.90	0.87
Production (Million bales*)	3.31	5.26	6.19	8.16	8.29	9.23	10.84	11.27	11.21	10.37	11.82	10.62	11.40	11.30
Yield (kg/hectare)	1043	1049	1032	1130	1646	1634	2173	2170	2101	2071	2349	2192	2283	2338

*1 bale = 180 kg.

Source : Agricultural Statistics at a glance, 2013, pp. 114-15.

TABLE 22.23. Distribution of Jute and Meslin in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million bales*	%age of all India	(kg/hectare)
1. West Bengal	0.58	66.67	8.31	73.54	2579
2. Bihar	0.15	17.24	2.09	18.50	2508
3. Assam	0.07	8.05	0.58	5.13	1491
4. Andhra Pradesh	0.02	2.30	0.13	1.15	1170
5. Odisha	0.02	2.30	0.08	0.71	270
6. Maharashtra	0.02	2.30	0.03	0.27	270
7. Meghalaya $	—	0.00	—	0.00	
Others	0.01	1.15	0.08	0.71	@
All India	**0.87**	**100.00**	**11.30**	**100.00**	**2338**

@ Since area/production is low in individual states, yield rate is not worked out.
$ Area and Production figures for 2012-13 are included in others category.
Source : Agricultural Statistics at a glance, 2013, p. 116.

Others. Among the other producers, is **Andhra Pradesh** were delta area is the main producer. In **Odisha**, Cuttack, Puri and Bolangir are the main producers. In **Uttar Pradesh**, areas along the Himalayan foothills including Kheri, Bahraich and Sitapur districts are the main producers. Some jute is also produced in Maharashtra, Kerala, Madhya Pradesh, Tripura and Meghalaya.

Trade

India's production of jute always falls short of her requirements and it is imported to feed our jute mills. Bangladesh is the chief supplier of jute to India. India imports raw jute and exports jute hessian. There are large temporal variations in the imports of row jute and exports of jute hessian (**Table 22.24**).

Being a natural fibre, jute is biodegradable and as such "environment friendly". The principal products can be reused and, as a result, many have a secondary value for other users. Despite such positive features, the world market for jute has remained depressed. The primary cause of such a situation is the development of substitutes like plastic products, synthetic fibres, paper package, etc.

SUGARCANE

Sugarcane belongs to bamboo family of plants and is *indigenous to India*. It is the main source of sugar, *gur* and *khandsari*. About two-thirds of the total sugarcane produced in India is consumed for making *gur* and *khandsari* and only one-third of it goes to sugar factories. It also provides raw material for manufacturing alcohol. Bagasse, the crushed cane residue, can be more beneficially used for manufacturing paper instead of using it as fuel in the

TABLE 22.24. India : Imports of Raw Jute and Exports of Jute Hessian

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Imports of raw jute ('000 tonnes)	143.23	111.97	20.74	61.34	83.05	135.75	52.24	62.66	83.31	181.18	148.73
Value of exports of jute hessian (₹ crore)	349.31	410.11	427.20	490.90	375.81	464.44	415.59	307.63	722.87	945.83	868.46

Source : Agricultural Statistics at a glance, 2012, pp. 245-249 and 2013 pp. 243-47.

mills. It is also an efficient substitute for petroleum products and a host of other chemical products. A part of it is also used as fodder. Sugarcane accounts for the largest value of production and holds an enviable position among all the commercial crops in India. Obviously, it is the first choice of the farmers, wherever geographical conditions favour its growth.

Conditions of Growth

It is a long duration crop and requires 10 to 15 and even 18 months to mature, depending upon the geographical conditions. It requires hot and humid climate with average temperature of 21°-27°C and 75-150 cm rainfall. In the latter half, temperature above 20°C combined with open sky helps in acquiring juice and its thickening. Too heavy rainfall results in low sugar content and deficiency in rainfall produces fibrous crop. Irrigation is required in areas receiving lesser rainfall than the prescribed limit. Short cool dry winter season during ripening and harvesting is ideal. Frost is detrimental to sugarcane. Therefore, it must be harvested before frost season, if it is grown in northern parts of the country where winters are very cold and frost is a common phenomenon. On the other hand, hot dry winds are also inimical to sugarcane.

It can grow on a variety of soils including loams, clayey loams, black cotton soils, brown or reddish loams and even laterites. In fact, sugarcane can tolerate any kind of soil that can retain moisture. But deep rich loamy soils are ideal for its growth. The soil should be rich in nitrogen, calcium and phosphorus but it should not be either too acidic or too alkaline. Sugarcane exhausts the fertility of the soil quickly and extensively and its cultivation requires heavy dose of manures and fertilizers. Flat plain or level plateau is an advantage for sugarcane cultivation because it facilitates irrigation and transportation of cane to the sugar mills.

It is a labour intensive crop requiring ample human hands at every stage *i.e.* sowing, hoeing, weeding, irrigating, cutting and carrying sugarcane to the factories. Therefore, cheap abundant labour is a prerequisite for its successful cultivation.

Production

India has the largest area under sugarcane cultivation in the world and she is the world's second largest producer of sugarcane next only to Brazil. The cane production registered a dramatic increase of 93 per cent in the decade 1951-61 as a result of diversification of agriculture but this spurt slackened to 14.9 per cent growth between 1960-61 and 1970-71 mainly as a result of the farmers' withdrawal of land under cane owing to internal market fluctuations. However, production began looking up again with the establishment of a number sugar mills during the decade 1971-81 and growth rate was 22 per cent. The production of sugarcane reached a high level of 355.52 million tonnes in 2006-07 after which varying trends have been observed. In the year 2012-13, production of sugarcane in India stood at 338.96 million tonnes.

As in case of production, area under sugarcane cultivation registered a rapid increase from 1.7 million hectares in 1950-51 to 4.32 million hectares in

TABLE 22.25. Area, Production and Yield of Sugarcane in India

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Area (Million hectares)	1.71	2.62	2.62	2.67	3.69	4.32	4.20	5.15	5.06	4.42	4.17	4.88	5.04	5.06
Production (Million tonnes)	57.05	110.00	126.37	154.25	241.05	295.96	286.17	355.52	348.19	285.03	292.30	342.38	357.67	338.96
Yield (kg/hectare)	33422	45549	48322	57844	65395	68578	66919	69022	68877	64553	74020	70091	70317	66988

Source : Agricultural Statistics at a glance, 2012, pp. 115-16.

2000-01 after which the area under sugarcane cultivation increased at a slow rate. In fact, large variations in area under sugarcane have been observed since 2006-07 onwards.

The yield of sugarcane doubled in four decades increasing from just 33422 kg/hectare in 1950-51 to 65395 kg/hectare in 1990-91. The process of increase in yields continued till 2000-01 when it stood at 68578 kg/hectare. The yield remained at this high level for three consecutive years from 1997-98 to 1999-2000. Again the yield recorded a rapid increase from 64553 kg/ha in 2008-09 to 70713 kg/ha in 2011-12. Our yields stand nowhere when compared with some of the best in the world. For example, countries like Indonesia, Egypt and Mexico are producing about 50 per cent more sugarcane/hectare as compared to India. As against India's 66.9 tons/ha in 2012-13, the yields of Brazil (79.0 tonnes/ha), Columbia (101.3 tonnes/ha), Australia (71.4 tonnes/ha), Egypt (116.7 tonnes/ha) and Peru (125.5 tonnes/ha) are much higher. Three new breeds of sugarcane namely Co238, Co239 and Co118 have been developed by at Coimbatore based Sugarcane Breeding Institute which are likely to give 10 tonnes more cane per hectare and bringing India at par with Brazil, a country which produces largest quantity of sugarcane. Lack of fertilizers, uncertain weather conditions, inadequate irrigation, poor varieties of cane, small and fragmented holdings and backward methods of cultivation are some of the major causes of low yields in India.

Sugarcane Research Institute set up at Coimbatore in Tamil Nadu started functioning in 1912. It evolved better varieties of cane, particularly for northern India. One of the important achievements of this institute was introduction of *ratooning* which became very popular in India. In this system the sugarcane is cut leaving the root intact in the soil. Ratoon crop is the second or any other successive crop obtained from the roots left over in the field from the first crop. This is widely practised in different parts of the country due to its low cost of production and relatively shorter maturation period, because cost inputs and time are saved as there is no need for fresh sowing and growing of roots. However, productivity decreases with each passing year and ratooning becomes uncommercial after one or two years.

Distribution

On the basis of study of conditions of growth for sugarcane as mentioned in the above paragraphs, following three distinct belts of sugarcane cultivation can be identified.

(*i*) The Satluj-Ganga plain from Punjab to Bihar containing 51 per cent of the total area and 60 per cent of the country's total production.

(*ii*) The black soil belt from Maharasthra to Tamil Nadu along the eastern slopes of the Western Ghats.

(*iii*) Coastal Andhra and the Krishna Valley.

Here, it is worth drawing a comparison between sugarcane cultivation in the northern and the southern parts of India. In northern plain of India, the summer temperatures ranging from 30° to 35°C and dry scorching winds called '*loo*' in May and June hamper the normal growth of the cane. In the winter months of December and January the sugarcane crop is likely to be damaged by excessively cold weather accompanied by frost. Consequently the yield/hectare is low. In south India, on the other hand, the absence of '*loo*' during the summer and reasonably high temperature during the frost free winter, coupled with the maritime winds in the coastal areas are some of the climatic factors which are extremely beneficial to this crop. The paradoxical character of sugarcane cultivation in India is that whereas south India offers more favourable climatic conditions for the growth of sugarcane, the most important sugarcane belt lies in north India. There are two reasons for such a contradictory situation. Before the World War I, this area was mainly used for growing indigo which was the most favourite cash crop with the farmers at that time. But with the introduction of cheap aniline dyes, indigo lost its market and its cultivation had to be discontinued after the First World War. Consequently, its place was taken by sugarcane cultivation. Another reason is that sugarcane has to face tough competition for land from a number of other cash crops such as cotton, tobacco, groundnut, coconut, etc. in the south.

1. Uttar Pradesh. **Table 22.26** clearly shows that Uttar Pradesh far excels all other states with regard to production and area under sugarcane. The state accounts for about 36 per cent of the production and about 42.86 per cent of the area under sugarcane cultivation of India. In fact, all parts of the state

TABLE 22.26. Distribution of Sugarcane in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million bales*	%age of all India	(kg/hectare)
1. Uttar Pradesh	2.16	42.86	128.82	35.68	59639
2. Maharashtra	1.02	20.24	86.73	24.02	85029
3. Karnataka	0.43	8.53	38.81	10.75	90256
4. Tamil Nadu	0.35	6.94	38.58	10.69	110229
5. Andhra Pradesh	0.20	3.97	16.69	4.62	83450
6. Bihar	0.22	4.37	11.29	3.13	51318
7. Gujarat	0.20	3.97	12.75	3.53	63750
8. Haryana	0.10	1.98	6.96	1.93	69600
9. Uttarakhand	0.11	2.18	6.31	1.75	57364
10. Punjab	0.08	1.59	5.65	1.56	70625
11. Madhya Pradesh	0.07	1.39	2.68	0.74	38286
12. West Bengal	0.02	0.40	1.68	0.47	84000
13. Assam	0.03	0.60	0.99	0.27	33000
14. Odisha	0.01	0.20	0.88	0.24	88000
Others	0.04	0.79	2.22	0.61	@
All India	**5.04**	**100.00**	**361.04**	**100.00**	**71668**

@ Since area/production is low in individual states, yield rate is not worked out.
Source : Agricultural Statistics at a glance, 2013, p. 119.

except a few dry areas in the west and south-west produce sugarcane to some extent. Vast alluvial plains, congenial climate and large scale use of irrigation and fertilizers are some of the important factors which have helped U.P. to acquire this status. The largest concentration is in the upper Ganga-Yamuna Doab, Rohilkhand and trans-Saryu areas which together produce about 70 per cent of sugarcane produced in this state. Western part of the state forms the core of sugarcane production in the country. As many as 30 districts of U.P. produce sugarcane. However, Muzaffarnagar, Meerut, Bijnor, Moradabad, Saharanpur, Kheri, Deoria, Bulandshahr, Ghaziabad, Bareilly and Sitapur are the important sugarcane producing districts.

2. Maharashtra. Though Maharashtra is the second largest producer of sugarcane in India, this state lags far behind U.P. with respect to area and the production accounting for about 24 per cent of the production and 20 per cent of the area of the country. But Maharashtra is in a superior position with respect to recovery of sugar and duration of crushing period. Maharashtra's yields are about 33 per cent higher than those of Uttar Pradesh. Most of the sugarcane is grown on black lava soil with the help of irrigation. Most of the production comes from Ahmednagar, Kolhapur, Pune, Nashik, Solapur, Sangli, Satara, Osmanabad and Aurangabad.

3. Karnataka. With over 10.7 per cent of the production and over 8 per cent of the area, Karnataka is the third largest sugarcane producing state of India. Most of the sugarcane is grown with the help of irrigation. Belgaum, Mandya, Mysore, Bijapur, Shimoga and Chitradurga are important producing districts.

4. Tamil Nadu. Though Tamil Nadu accounts only for about 10.69 per cent of the production and nearly 7 per cent of the area under sugarcane of the country, this state has unique distinction of giving highest yield of 1,10,229 kg/hectare. Over 80 per cent of the production comes from Tirupur, Salem, Tiruchirapalli, Dharampuri and Coimbatore districts. The rest is contributed by Dharampuri, Madurai, Thanjavur and Ramnathpuram districts.

5. Andhra Pradesh. Most of the cultivation is done in the coastal areas having fertile soil and suitable climate. West Godavari, East Godavari, Vishakhapatnam, Krishna, and Srikakulam are important producers.

6. Bihar. Bihar's main sugarcane producing areas comprise a continuation of the main sugarcane producing belt of U.P. In the recent years, area under sugarcane has decreased because much of the sugarcane area has been shifted to wheat cultivation.

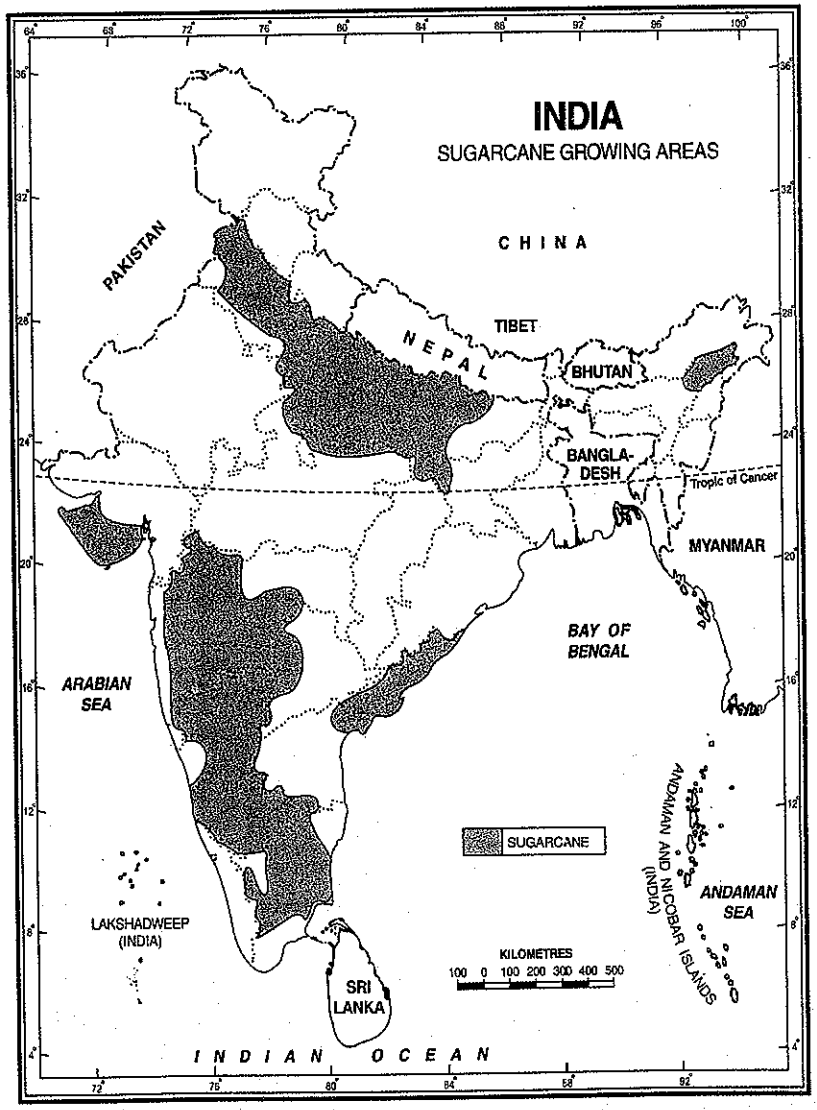

FIG. 22.4. India : Sugarcane Growing Areas

Champaran, Gaya, Saran, Muzaffarpur, Darbhanga and Patna are the main producing districts.

7. Gujarat. Gujarat produces only 3.53 per cent sugarcane from nearly 4 per cent area of India. Its recovery of 10.31 per cent of sugar is one of the highest among the major sugar cane producing states of India. Surat, Bhavnagar, Rajkot, Junagadh and Jamnagar are the important sugarcane producing districts.

8. Haryana. Haryana has progressed a lot in sugarcane cultivation during the last few years mainly due to the extension of irrigation facilities. It is an important cash crop in the fertile areas of Karnal, Kaithal, Ambala, Kurukshetra, Rohtak, Hisar, Panipat, Sonepat, Gurgaon and Faridabad districts. However, it avoids western dry districts.

9. Uttarakhand. Most of Uttarakhand is a hilly and mountainous area and is not suitable for sugarcane cultivation. However, parts of Udham Singh Nagar, Haridwar, Nainital and Dehra Dun districts are plain areas or areas located at the foothills. As such these districts help the state to produce about 1.75 per cent sugarcane of India. Udham Singh Nagar is basically a tarai area which is very rich from agriculture point of view. This district contributes major part of sugarcane production of the state.

10. Punjab. Sugarcane cultivation in Punjab has suffered a lot on account of shift in favour of wheat after the introduction of Green Revolution strategy. Still Gurdaspur, Jalandhar, Sangrur, Rupnagar, Patiala, Ludhiana, Firozepur, Amritsar districts are important producers of sugarcane in Punjab.

Others. Koraput, Cuttack, Puri and Sambalpur in *Odisha*; Gwalior, Morena, Ratlam in *M.P.*, Brahamputra valley in *Assam*, Burdwan, Birbhum, Hugly, Malda, North 24 Parganas, Nadia and Murshidabad in *West Bengal* and Ganganagar, Kota, Chittaurgarh, Bundi, Bhilwara and Udaipur districts in *Rajasthan* are other important producers of sugarcane in India.

TOBACCO

Tobacco is another important cash crop of India. This was brought to India by the Portuguese in 1508. Since then its cultivation has spread to different parts of the country and at present India is an important producer of tobacco in the world. Tobacco is mainly used for smoking in the form of cigarette, *bidi*, cigar, cheroot and *hookah* and is chewed also. It is also used for manufacturing insecticides. Normally speaking, tobacco is to be grown in rotation with other crops but the cash returns from this crop are so high that it is grown year after year on the same land in many parts of India. Surprisingly, it is the common opinion in many parts of Andhra Pradesh and Maharashtra that the quality of tobacco is much improved if it is continuously grown for many years on the same piece of land.

Conditions of Growth

It is a plant of tropical and sub-tropical climates and can withstand a wide range of temperature varying from 16° to 35°C. It normally requires 100 cm of annual rainfall but it can also be successfully grown in areas of 50 cm annual rainfall provided the rainfall is fairly distributed. Irrigation is required in areas of lower and erratic rainfall. Frost is injurious to its growth. Bright rainless weather is helpful at the curing stage. Well drained friable sandy loams, not too rich in organic matter but rich in mineral salts allowing full development of roots are best suited for tobacco. Soil is more important than climate. In fact, *soil rather than climate is the determining factor for its geographical distribution*. Further it can be grown from low lying flat plains upto a height of 1,800 metres. Cheap and abundant labour is required at all stages of its cultivation, starting from field preparation, transplantation, weeding, harvesting, processing and preparing it for the market.

Types of Tobacco

Broadly speaking, two types of tobacco are grown in India.

(*i*) *Nicotiana Tobacum* is of better quality and is used for cigarette, cigar, cherroot, *bidi*, chewing, snuff, *hookah* and pipe. The plant is tall and has long broad leaves with pink flowers. About 90 per cent of the total tobacco production in India is of this type.

(*ii*) *Nicotiana Rustica* needs cool climate and is mainly grown in northern and north-eastern parts of the country. Its plant is comparatively shorter and has round and puckered leaves and yellow flowers. It is grown mainly for *hookah*, chewing and snuff. It accounts for about 10 per cent of the total tobacco production of India.

Production

With a production of 8.2 lakh tonnes in 2011-12, India is the third largest tobacco producing country of the world after China (31.59 lakh tonnes) and Brazil (9.52 lakh tonnes) and accounts for 11.25 per cent of the world's total tobacco production. India is followed by USA, Malawi, Indonesia and Argentina in descending order with respect to production of tobacco. The production of tobacco had been slowly increasing and had more than doubled from 0.26 million tonnes in 1950-51 to 0.56 million tonnes in 1990-91. Varying trends in production have been observed between 1990-91, and 2007-08 after which there has been rapid increase in production. Similarly, the area under tobacco cultivation had increased from 0.36 million hectares in 1950-51 to 0.41 million hectares in 1990-91. The area suddenly fell to 0.26 million hectares in 2000-01 but picked up very fast to reach the highest level of 0.49 million hectares in 2010-11. The yield per hectare had also increased by about 2.5 times from 731 kg in 1950-51 to 1,772 kg in 2011-12. Trends of production, area and yield of tobacco in India from 1950-51 to 2011-12 are shown in **Table 22.27**.

Distribution

Although tobacco is grown in as many as 15 states of India, only two states *viz*. Gujarat and Andhra Pradesh account for about 65.3 per cent of the production and 62.42 per cent of the hectarage under tobacco in the country.

TABLE 22.27. Area, Production and Yield of Tobacco in India

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12
Area (Million hectares)	0.36	0.40	0.45	0.45	0.41	0.26	0.37	0.37	0.35	0.39	0.44	0.49	0.46
Production (Million tonnes)	0.26	0.31	0.36	0.48	0.56	0.34	0.50	0.47	0.44	0.57	0.69	0.83	0.82
Yield (kg/hectare)	731	766	810	1065	1353	1318	1351	1274	1255	1456	1559	1687	1772

Source : Agricultural Statistics at a glance, 2013, pp. 120-21.

TABLE 22.28. Production of Tobacco in India (2011-12)

States	Area		Production		Yield
	'000 hectares	%age of all India	'000 tonnes	%age of all India	(kg/hectare)
1. Gujarat	158.00	34.01	279.00	33.89	1,766
2. Andhra Pradesh	132.00	28.41	259.00	31.46	1,962
3. Uttar Pradesh	24.05	5.18	124.70	15.15	5,185
4. Karnataka	115.00	24.75	106.00	12.87	922
5. Bihar	9.94	2.14	18.74	2.28	1,885
6. Tamil Nadu	2.87	0.62	4.38	0.53	1,526
7. Maharashtra	0.95	0.20	1.10	0.13	1,158
Others	21.76	4.68	25.74	3.13	1,183
All India	**464.57**	**100.00**	**823.33**	**100.00**	**1,772**

@ Since area/production is low in individual states, yield rate is not worked out.

Source : Agricultural Statistics at a glance, 2013, p. 122.

1. Gujarat. According to 2011-12 figures, Gujarat produced 279 thousand tonnes (33.89% of India) of tobacco from 158 thousand hectares (34% of India) of land giving the yield of 1,766 kg/hectare. About 90 per cent of Gujarat's tobacco comes from Kheda and Vadodara districts.

2. Andhra Pradesh. Andhra Pradesh has been the traditional producer of tobacco in India. In the year 2011-12, Andhra Pradesh accounted for 259 thousand tonnes (31.46% of all India) of tobacco from 132 thousand hectares (28.41% of all India) of land with an average yield of 1962 kg/hectare. This is higher than the yield of Gujarat and much lower than that of Uttar Pradesh, Prakasam, West Godawari, East Godavari, Krishna, Kurnool and Nellore are the main producing districts.

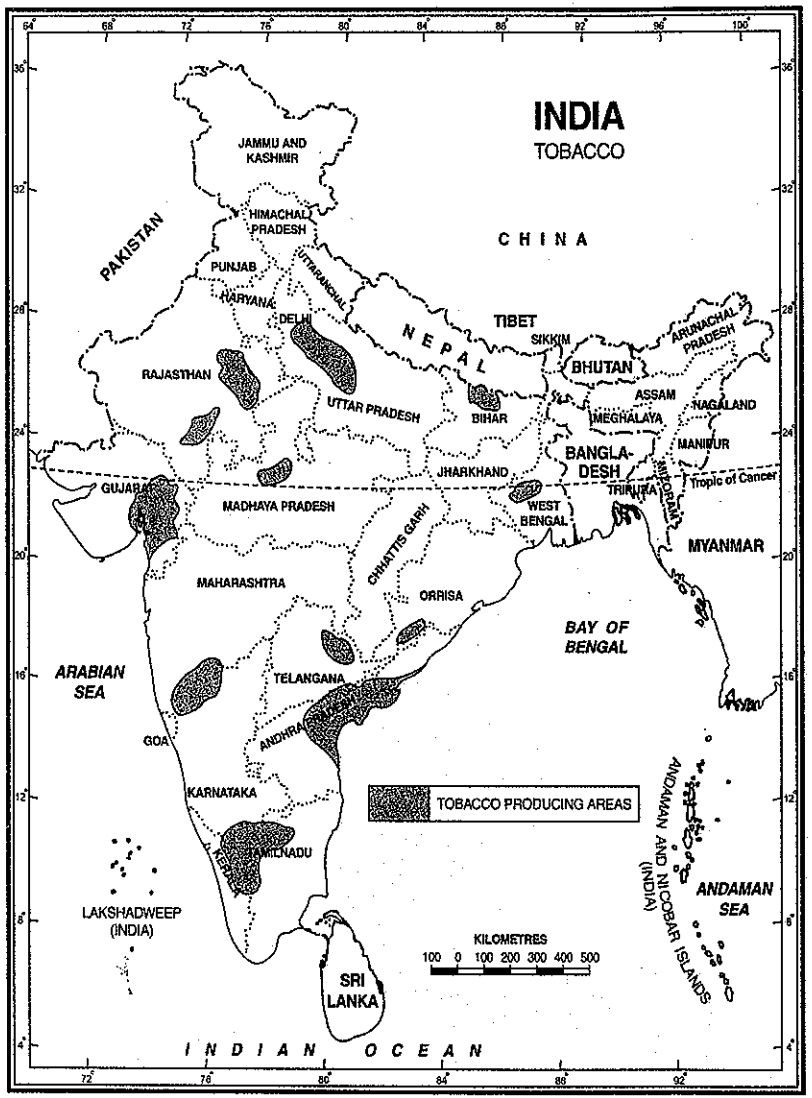

FIG. 22.5. India : Tobacco

TABLE 22.29. Value of Tobacco Exports (₹ crore)

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Unmanufactured Tobacco	733.52	801.41	940.07	1021.32	1251.28	1432.80	2766.27	3621.44	3151.65	2898.56	3814.98
Manufactured Tobacco	289.37	295.06	314.54	309.34	433.89	499.09	294.78	722.96	833.74	1106.96	1221.03

Source : Agricultural Statistics at a glance, 2012, pp. 247-48.

Others. The other tobacco producing states in India are Uttar Pradesh (15.1%), Karnataka (12.9%) Bihar (2.3%), Tamil Nadu (0.53%), and Maharashtra (0.13%). It is worth noting that Uttar Pradesh gives the highest yield of 5,185 kg/ha against the national average of 1,772 kg/ha, although this state contributes a little over 15 per cent of the total tobacco production of India.

Trade

About 80 per cent of the total production of tobacco is used within the country and the remaining 20 per cent is exported. India is world's fourth largest exporter of tobacco. In 2012-13, the value of tobacco exports from India was ₹ 5036 crore. **Table 22.29** shows that bulk of India's tobacco export consists of unmanufactured tobacco and less than half to one-third of the foreign exchange is earned from the export of manufactured tobacco. Presently India exports tobacco to about 60 countries. Russia and U.K. purchase about two-third of our total tobacco exports. The other important buyers of Indian tobacco are Japan, Egypt, Sri Lanka, Nepal, Indonesia, Germany and Singapore. About 90 per cent of the tobacco export trade is handled by Chennai alone, the rest being handled by Kolkata, Mumbai and Vishakhapatnam. To make Indian tobacco more competitive in the world market in terms of price and quality, varieties with enhanced productivity and desirable quality traits should be developed.

OILSEEDS

Oilseeds constitute a very important group of commercial crops in India. The oil extracted from oilseeds form an important item of our diet and are used as raw materials for manufacturing large number of items like paints, varnishes, hydrogenated oil, soaps, perfumery, lubricants, etc. Oil-cake which is the residue after the oil is extracted from the oilseeds, forms an important cattle-feed and manure.

India has the largest area and production of oilseeds in the world. Nine major oil seeds *viz.*, groundnut, sesamum, rapeseed and mustard, linseed, safflower, castor seed, sunflower, and soyabean occupied 26.53 million hectares (2012-13) which is over 18 per cent of the net area sown. **Table 22.30** shows that there had been gradual increase in area, production and yield of oilseeds, with the passage of time, some short lived variations notwithstanding.

It must, however, be noted that the production of oilseeds has always fallen short of our demand and there has always been a need to import oilseeds or their products for meeting the demand of our evergrowing population.

TABLE 22.30. Area, Production and Yield of Nine Oilseeds in India

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Area (Million hectares)	10.73	13.77	16.64	17.60	24.15	22.77	27.86	26.51	26.69	27.56	25.96	27.22	26.31	26.53
Production (Million tonnes)	5.16	6.98	9.63	9.37	18.61	18.77	27.98	24.29	29.76	27.72	24.88	32.48	29.80	31.01
Yield (kg/hectare)	481	507	579	532	771	810	1014	916	1115	1006	958	1193	1133	1169

Source : Agricultural Statistics at a glance, 2013, pp. 96-97.

TABLE 22.31. Distribution of nine oilseeds in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million tonnes	%age of all India	(kg/hectare)
1. Madhya Pradesh	7.54	28.42	9.28	29.93	1,231
2. Rajasthan	4.92	18.55	6.2	19.99	1,260
3. Maharashtra	3.7	13.95	5.02	16.19	1,357
4. Gujarat	2.54	9.57	2.89	9.32	1,138
5. Andhra Pradesh	1.94	7.31	1.64	5.29	845
6. Uttar Pradesh	1.16	4.37	1.04	3.35	897
7. Haryana	0.58	2.19	0.99	3.19	1,707
8. Karnataka	1.46	5.5	0.95	3.06	651
9. Tamil Nadu	0.43	1.62	0.9	2.9	2,093
10. West Bengal	0.74	2.79	0.83	2.68	1,122
11. Odisha	0.24	0.9	0.17	0.55	708
12. Assam	0.28	1.06	0.17	0.55	607
13. Bihar	0.14	0.53	0.16	0.52	1,143
14. Punjab	0.05	0.19	0.07	0.23	1,400
Others	0.81	3.05	0.7	2.26	@
All India	**26.53**	**100**	**31.01**	**100**	**1,169**

@ Since area/production is low in individual states, yield rate is not worked out.
Source : Agricultural Statistics at a glance, 2013, p. 98.

With limited scope of bringing additional area under oilseeds, increase in oilseed production will have to come primarily from land saving technologies highlighting a combination of high yield plant type, standard crop management practices and balanced crop nutrition.

There have been large scale regional variations in area, production and productivity changes in oilseeds. Only a few states like Haryana, Madhya Pradesh, Rajasthan and West Bengal increased their oilseed production both through area expansion and productivity improvement. States like Maharashtra, Tamil Nadu and Himachal Pradesh increased their oilseed output mainly through productivity improvement. In some states like Odisha, area productivity and production declined sharply.

Table 22.31 shows that Madhya Pradesh, Rajasthan, Maharashtra and Gujarat are the main producers of nine oilseeds and account for over two-third of the area and more than three-fourths of the production of India. Tamil Nadu gives maximum yield of 2,093 kg/hectares. Other producers include Andhra Pradesh, Uttar Pradesh, Haryana, Karnataka, Tamil Nadu, West Bengal, Odisha, Assam, Bihar and Punjab.

GROUNDNUT

Groundnut is the most important oilseed of India and accounts for a little less than half of the major oilseeds produced in the country. Groundnut kernels are rich in proteins and vitamins and have high calorific value. It contains 40-50 per cent oil which is mainly used as edible oil in its pure form or in hydrogenated vanaspati form. The groundnut oil is also used for manufacturing margarine, medical emulsions, soap and toilet requisites. Groundnut is eaten raw, roasted, sweetened or salted. Its oil cake is used as an important rich cattle feed. It serves as an important rotation crop because it syntehsizes atmospheric nitrogen and increases the fertility of soil.

TABLE 22.32. Area, Production and Yield of Groundnut in India

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13
Area (Million hectares)	4.49	6.46	7.33	6.80	8.31	6.56	6.74	5.62	6.29	6.16	5.48	5.86	5.26	4.77
Production (Million tonnes)	3.48	4.81	6.11	5.01	7.51	6.41	7.99	4.86	9.18	7.17	5.43	8.26	6.96	4.75
Yield (kg/hectare)	775	745	834	736	904	977	1187	886	1459	1163	991	1411	1323	996

Source : Agricultural Statistics at a glance, 2012, pp. 97-98.

Conditions of Growth

It thrives best in the tropical climate and requires 20°-30°C temperature and 50-75 cm rainfall. Isohyet of 100 cm marks the upper limit of groundnut cultivation. It is highly susceptible to frost, prolonged drought, continuous rain and stagnant water. Dry winter is needed at the time of ripening. It can be grown both as a *kharif* and as a *rabi* crop but 91 per cent of the total area under groundnut is devoted to *kharif* crop. Well drained light sandy loams, loams, red, yellow and black cotton soils are well suited for its cultivation.

Production and Distribution

India is the second largest producer of groundnut contributing about 17.4% of the world's total production but is way behind China's 40.27 per cent. **Table 22.32** shows that there had been large scale temporal variations in area production and yields of groundnut depending on the farmer's choice of crops and weather conditions. It must be noted that groundnut is primarily a rainfed crop and there are bound to be fluctuations in its production, area and yield depending upon the amount of rainfall and its temporal distribution.

Table 22.33 shows that Andhra Pradesh, Tamil Nadu, Gujarat and Rajasthan are the four main producers. These four states together account for over 70% of total production of India. ***Andhra Pradesh*** is the largest producer of groundnut in India and accounts for over 23 per cent of India's total production. About 50 per cent of the state's production comes from Chittoor, Kurnool and Anantpur districts, though other districts also produce sufficient groundnut. ***Tamil Nadu*** is the second largest producer accounting for over 18 per cent of the total groundnut produced in India. Salem, Tiruchirapalli and Coimbatore districts produce half of the state's total output. ***Gujarat*** is the third largest producer contributing 16 per cent of India's total production. About 60 per cent of the state's total production comes from Junagadh, Jamnagar, Amreli, Bhavnagar, Rajkot, Sabarkantha, Panchmahals and Surat districts. ***Rajasthan*** produces over 13 per cent of India's groundnut. Chittaurgah, Bhilwara, Tonk, Jhalawar, and Jaipur are the main producing districts. ***Karnataka*** produces over 8 per cent of India's groundnut. Dharwar, Gulbarga, Belgaum, Bellary, Kolar, Tumkur, Raichur and Mysore districts supply about three-fourths of the state's total production. ***Maharashtra*** produces about 5 per cent of India's groundnut. Jalgaon, Dhule, Kolhapur, Satara, Osmanabad, Yavatmal, Nashik and Amravati districts produce about two-thirds of the state's production.

The other producers in order of importance are Odisha, Madhya Pradesh and Uttar Pradesh. West Bengal, Kerala, Punjab, Haryana and Bihar also produce small quantities of groundnut.

Trade

About 75 per cent of the total production enters the interestate trade—the main traders being Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra, Karnataka and Punjab. India's capacity to export groundnut and its products has drastically been reduced due to increased domestic consumption resulting from rapid population growth. However, groundnut cake is still exported to U.K. and other European countries and to Russia.

TABLE 22.33. Distribution of Groundnut in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million tonnes	%age of all India	(kg/hectare)
1. Andhra Pradesh	1.35	28.30	1.11	23.37	822
2. Tamil Nadu	0.36	7.55	0.86	18.11	2,389
3. Gujarat	1.29	27.04	0.76	16.00	589
4. Rajasthan	0.40	8.39	0.62	13.05	1,550
5. Karnataka	0.65	13.63	0.41	8.63	631
6. Madhya Pradesh	0.21	4.40	0.31	6.53	1,476
7. Maharashtra	0.22	4.61	0.25	5.26	1,136
8. Uttar Pradesh	0.09	1.89	0.09	1.89	1,000
9. Odisha	0.07	1.47	0.08	1.68	1,143
Others	0.13	2.73	0.26	5.47	@
All India	**4.77**	**100.00**	**4.75**	**100.00**	**996**

@ Since area/production is low in individual states, yield rate is not worked out.
Source : Agricultural Statistics at a glance, 2013, p. 101.

SESAMUM (*Til*)

Sesamum contains 45 to 50 per cent oil which is used for cooking purposes and for manufacturing perfumery and medicines. Sesamum seeds are eaten in fried form mixed with sugar or gur. Its oil-cake is fed to milch cattle.

Conditions of Growth

Sesamum is a rainfed crop and requires 45-50 cm rainfall. It thrives well in areas having 21°-23°C temperature. Frost, prolonged drought and heavy rains for a longer duration are harmful to this crop. Well-drained light loamy soils are best suited to sesamum. It is cultivated in plains as well as on elevations upto 1,300 metres. It is grown as a *kharif* crop in the north and as a *rabi* crop in the south.

Production and Distribution

India has the world's largest area under sesamum and is also the largest producer of this crop accounting for one-third of the world production. Since it is a rainfed crop, the production figures show fluctuating trends. But there has been an overall 87 per cent increase in its production from 4.5 lakh tonnes in 1950-51 to a record 8.4 lakh tonnes in 1990-91. After that, the production had fluctuated but the general trend had been on the decline. Signs of recovery had been seen in 1996-97 and 2001-02 but generally the country fails to maintain a higher level of production. The overall production declined from 698 thousand tonnes in 2001-02 to 618 thousand tonnes in 2006-07. The decline is still continuing.

Sesamum is produced in almost all parts of the country but West Bengal is the largest producing state and accounts for about one-third of the total production of India. The other major producers are Gujarat, Rajasthan, Maharashtra, Tamil Nadu, Karnataka, Madhya Pradesh, Andhra Pradesh and Uttar Pradesh.

RAPESEED AND MUSTARD

Next to groundnut, rapeseed and mustard are two most important oilseeds of India. The oil content of these seeds is 25-45% which is used as a cooking medium, preservative for pickles, lubricants and toiletteries. Oil cake forms an important cattlefeed and is also used as manure.

TABLE 22.34. Area, Production and Yield of Rapeseed and Mustard in India

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13
Area (Million hectares)	2.07	2.88	3.32	4.11	5.78	4.48	7.28	6.79	5.83	6.30	5.59	6.90	5.89	6.34
Production (Million tonnes)	0.76	1.35	1.98	2.30	5.23	4.19	8.13	7.44	5.83	7.20	6.61	8.18	6.60	7.82
Yield (kg/hectare)	368	467	594	560	904	936	1117	1095	1001	1143	1183	1185	1121	1234

Source : Agricultural Statistics at a glance, 2013, pp. 102-03.

Conditions of Growth

Like wheat and gram, they thrive only in cool climate of the Satluj-Ganga plain and very small quantity is grown in the peninsular India. They are mainly grown as rabi crop in pure or mixed form with wheat, gram and barley.

Production and Distribution

India and is world's third largest producer after Canada and China, accounting for about 10% of world's production. There has been nearly four-fold increase in their production in three decades from 1960-61 to 1991 after which varying trends of production have been noticed.

But considerable increase in production and yield has been recorded from 2000-01 to 12-13 (**Table 22.34**).

Rajasthan excells all other states with respect to production of mustard and rapeseed and produces over 46 per cent from over 44 per cent of area under these crops in India. Bharatpur, Kota, Alwar, Jaipur, Chittaurgarh, Tonk, Sawai Medhopur, Udaipur, Pali districts contribute the major part of production and cover large area. *Haryana* is the second largest producer and has the distinction of giving the highest yield of 1,714 kg/hectare. Hisar, Sirsa, Fatehabad, Mahandergarh, Rewari, Gurgaon, Mewat, Bhiwani are the chief producers. *Madhya Pradesh* is the third

TABLE 22.35. Distribution of Rapeseed and Mustard in India (2012-13)

States	Area		Production		Yield
	Million hectares	%age of all India	Million tonnes	%age of all India	(kg/hectare)
1. Rajasthan	2.83	44.64	3.65	46.68	1,290
2. Haryana	0.56	8.83	0.96	12.28	1,714
3. Madhya Pradesh	0.78	12.3	0.92	11.76	1,179
4. Uttar Pradesh	0.66	10.41	0.84	10.74	1,273
5. West Bengal	0.47	7.41	0.46	5.88	979
6. Gujarat	0.21	3.31	0.34	4.35	1,619
7. Assam	0.25	3.94	0.16	2.05	640
8. Bihar	0.09	1.42	0.11	1.41	1,222
9. Punjab	0.03	0.47	0.04	0.51	1,333
Others	0.46	7.26	0.34	4.35	@
All India	**6.34**	**100.00**	**7.82**	**100.00**	**1,233**

@ Since area/production is low in individual states, yield rate is not worked out.
Source : Agricultural Statistics at a glance, 2013, p. 104.

largest producer. Bhind, Morena and Gwalior are the main producing districts in this state. *Uttar Pradesh* is the triditional producer but has surrendered its top position during the last few years, partly due to fall in its own production and partly due to increase in production in other states. Agra, Faizabad, Meerut, Kanpur, Saharanpur, Etah and Etawah are the chief producing districts. *West Bengal* has also emerged as a major producer. West Dinajpur, Birbhum, Nadia and Murshidabad districts contribute the bulk of production. Gujarat, Assam, Bihar, Punjab, Odisha etc. are some of the other producing states.

LINSEED

Linseed has 35 to 47 per cent oil content. This oil has a unique drying property and is used for manufacturing paints, varnishes, printing ink, oil-cloth, and water-proof fabrics. It is also used as an edible oil in some parts of the country.

Conditions of Growth

Although this crop can be grown under varied geographical conditions, it prefers cool, moist climate with about 20°C temperature and 75 cm rainfall. Clay loams, deep black soils and alluvial soils are best suited for its cultivation. It can be cultivated upto a height of 800 metres above sea level. It is a *rabi* which is sown in Oct-Nov. and harvested in March-April.

Production and Distribution

India produces about 10 per cent of world's linseed and is world's third largest producer after Russia and Canada. However, there had been almost consistent decline in production during the last few years and the production had fallen from 322 thousand tonnes in 1990-91 to 168 thousand tonnes in 2006-07.

Madhya Pradesh, Bihar, Uttar Pradesh, Chhattisgarh and Maharashtra are the main producers accounting for about four-fifths of the total production of India. *Madhya Pradesh* is the largest producer accounting for 49 thousand tonnes (29%) of linseed. Balaghat, Satna, Rewa, Hoshangabad, Vidisha, Jhabua, Sagar, Guna and Panna contribute a major part of the production. *Bihar* is the second largest producer of linseed in India. In 2006-07, this state produced 24 thousand tonnes of linseed which was over 14 per cent of the all India production. Darbhanga, Purnea, Muzaffarpur, Bhagalpur, Rohtas and Champaran are the chief producing districts. *Uttar Pradesh* is the third largest producer with 19 thousand tonnes (11.3%) of linseed to its credit. Almost every district in Uttar Pradesh produces some linseed as a mixed crop but Agra, Etawah, Kanpur, Mirzapur, Allahabad, Gonda, Bahraich and Hamirpur are the main contributors. *Chhattisgarh* produced 17 lakh tonnes (10%) linseed in 2006-07. Durg, Raipur and Bilaspur are the main producing districts. *Maharashtra* produced 13 thousand tonnes accounting for over 9.5 per cent of the total production of India. Chandrapur, Osmanabad, Bhandara, Nagpur, Aurangabad, and Parbhani are the main producers. The other producers include Rajasthan, Odisha and Karnataka.

CASTOR SEED

Castor seed contains 50 per cent oil which is used for various purposes such as lubricant in various machines, hair oil, lighting and for manufacturing soap and leather tanning. Oil-cake is used as manure and leaves of the plant are fed to silk worms.

Conditions of Growth

Castor seed plant grows into a small tree and is generally raised as a mixed crop in tropical and sub-tropical climates. It thrives well in areas of 20°-25°C temperature and 50-75 cm rainfall. It is grown on red sandy loams in the peninsular India and on light alluvial soils of the Satluj-Ganga plain. Almost the whole area of castor seed production is rainfed. It is a *kharif* crop in the north and a *rabi* crop in the south.

Production and Distribution

India is the second largest producer of castor seed after Brazil and produces about one-fifth of the total world production. The production increased from a meagre one lakh tonnes in 1950-51 to all time record of over nine lakh tonnes in 1996-97. Thereafter, the production fell and stood at 7.6 lakh tonnes only in 2006-07. Gujarat, Rajasthan and Andhra Pradesh are the main producers. **Gujarat** is the largest producer of castor seed in India and accounts for more than two- thirds of the total production. Mehsana, Kheda, Sabarkantha, and Banaskantha are the main producing districts. **Rajasthan** is the second largest producer contributing about 13.6 per cent of India's castor seed. About half the production of this state comes from Sirohi district and the rest is produced by Jalore and Barmer districts. **Telangana** is also an important producer where major production comes from Nalgonda, Mahbubnagar, Warangal, Hyderabad and Rangareddi. The remaining castor seed is produced by Rajasthan, Odisha, Karnataka and Tamil Nadu.

PLANTATION CROPS

Plantation crops are those crops which are grown on plantations covering large estates. Unlike other crops, they are not annual crops and usually take 3-5 years to bear returns after they are sown. But once they start bearing fruit, they continue to do so for 35-40 years. They require heavy initial capital investment and high level technology for their growth and processing. They cover small area in India but are of high economic value. Tea, coffee and rubber are the principal plantation crops but spices are also included in this category. Tea and coffee crops are also famous as *beverage crops*. There are over 30,000 plantations in India giving full or part time employment to over 20 lakh persons. Most of the plantations are under tea, coffee and rubber.

TEA

Tea is the dried leaf of a bush. It contains theine and when added to boiling water along with sugar and milk, it gives a very cheap and stimulating drink. Thus it is the most important **beverage crop** of India.

Tea bush is supposed to be indigenous to China but it was reported by Major Robert Bruce in 1823 that indigenous tea bushes grew wild on the hill slopes of upper Assam. In the year 1840, tea seeds were imported from China and commercial tea plantations were set up in the Brahmaputra valley. To begin with, tea plantations were confined to Upper Assam only but later on, new areas such as lower Assam and Darjeeling were also opened up to tea plantations and by 1859, there were 30 tea plantations in Assam alone. Later on, tea plantations were also set up in Nilgiri Hills of South India, Tarai along the foothills of the Himalayas and in some places in Himachal Pradesh.

Conditions of Growth

Tea bush is a tropical and sub-tropical plant and thrives well in hot and humid climate. *There is a very close relation between climate, the yield and the quality of tea.* The ideal temperature for its growth is 20°-30°C and temperatures above 35°C and below 10°C are harmful for the bush. It requires 150-300 cm annual rainfall which should be well distributed throughout the year. While prolonged dry spell is harmful for tea, high humidity, heavy dew and morning fog favour rapid development of young leaves. Alternate waves of warm and cool winds are very helpful for tea leaves. Tea is a shade-loving plant and develops more vigorously when planted along with shady trees.

Tea bush grows well in well drained, deep, friable loams. However, virgin forest soils rich in humus and iron content are considered to be the best soils for tea plantations. Relatively large proportion of phosphorus and potash in the soil gives special flavour to tea as is the case in Darjeeling. In order to increase the yield, proper dose of nitrogenous fertilizers such as ammonium sulphate should be given to soil.

Although tea requires heavy rainfall for its growth, stagnant water is injurious to its roots. It is, therefore, grown on hill slopes where water drains away easily and waterlogging does not take place. However, it grows equally well in the valleys if the drainage is good. Most of the tea plantations in India are found at elevations ranging from 600 to 1,800 metres above sea level.

Tea is a labour intensive crop and requires abundant supply of cheap and skilled labour, especially at the time of plucking the tea leaves. This is a tedious process which requires skilled manipulation of fingers for plucking two leaves and a bud at a time. For this purpose, women labourers are employed in large numbers. Currently, tea industry provides employment to one million workers. Through its forward and backward linkages another 10 million people derive their livelihood from tea. It is one of the largest employers of women among organised industries of India. Women constitute over 50 per cent of the total workforce.

Method of Cultivation

Tea gardens are set up on the cleared hill slopes

TABLE 22.36. Area, Production and Yield of Tea in India

Year	1970-71	1980-81	1990-91	2000-01	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Area (Million hectares)	0.4	0.4	04	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Production (Million tonnes)	0.4	0.6	0.7	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yield kg/hectare	1182	1491	1784	1673	1705	1695	1695	1695	1695	1,730	1,730

Source : Economic Survey 2012-13, pp. A.17-19 and 2013-14 Statistical Appendix pp. 17-19.

where shade trees are planted in advance. Seeds are sown in the germination beds and the saplings transplanted to the garden. The garden is regularly hoed and weeded so that tea bush grows without any hindrance. Use of manures and fertilizers is a common practice in the gardens. Oil cakes and green manures are widely used. Pruning of the plant is an essential part of tea cultivation. It helps in maintaining the proper shape of tea bush to a height of about one metre with about the same diameter. The aim of pruning is to have new shoots bearing soft leaves in plenty and to facilitate the plucking of leaves by women labourers from the ground.

Production

Tea cultivation does not have long tradition in India as it started in the middle of nineteenth century only, when first tea plantations were established in Assam. However, tea cultivation has shown steady progress right from the beginning. At the time of Independence, tea gardens covered 3,011 lakh hectares producing 2.61 lakh tonnes of tea. The progress of tea cultivation in India from 1970-71 to 2013-14 is shown in **Table 22.36**.

This table shows that production and area of tea in India has increased by 2.5 times and 1.5 times respectively between 1970-71 and 2013-14 and its yield has increased by almost 1.5 times during the same period. At present, India is the third largest producer of tea in the world, next to China and Turkey and contributes 17.1 per cent of the world's tea production.

Distribution

Tea cultivation in India is highly concentrated in a few selected pockets. Following three areas of tea cultivation are identified according to their importance as tea producers and their location.

(1) North-East India (2) South India (3) North-West India.

TABLE 22.37. Distribution of tea in India (2005-06)

States	Area		Production		Yield	No. of tea gardens
	'000 hectares	%age of all India	'000 tonnes	%age of all India	Quintals/ hectare	
1. Assam	272	52.01	474	51.08	17.4	790
2. West Bengal	115	21.99	215	23.17	18.8	315
3. Tamil Nadu	76	14.53	155	16.70	20.3	6,795
4. Kerala	37	7.07	67	7.22	18.1	4,215
5. Tripura	8	1.53	8	0.86	8.7	15
6. Karnataka	2	0.38	5	0.54	25.3	25
Others	13	2.49	4	0.43	–	13,635
All India	**523**	**100.00**	**928**	**100.00**	**17.7**	

Source : Data collected from different sources.

1. North-Eastern India

It is more or less a triangular area mainly in Assam and West Bengal. It extends from 23°N to 28°N latitudes and 88°E to 96°E longitudes. This is the most important tea producing region of India accounting for about three-fourth production and about the same percentage of area under tea production. Tea plantations are small in number (see **Table 22.37**) but fairly large in size, generally more than 200 hectares.

Assam. Assam is the largest producer of tea accounting for over 51 per cent of the production and over 52 per cent of area under tea cultivation in India. The average yield is 17.4 quintals/hectare. Two destinct areas of tea production can be identified.

(*a*) ***The Brahmaputra Valley*** extending from Sadiya to Goalpara comprises the main tea producing belt. It accounts for 44 per cent of India's tea from 40 per cent of tea area of the country. There are 676 tea estates mainly in the districts of Dibrugarh, Lakhimpur, Sibsagar, Darrang, Kamrup, Nagaon, and Goalpara. With summer temperature of 30°C and winter temperature never falling below 10°C, frost free weather throughout the year and 300-400 cm annual rainfall extended over 9 months; the area provides ideal climatic conditions for tea cultivation. Tea estates are located on the raised grounds (upto 450 metres) so that annual inundations and stagnant water during the rainy season do not harm the crop.

(*b*) ***Surma Valley*** is the second important in producing area in Assam. This valley, lying in Cachar district, produces about 5 per cent of country's tea from 9 per cent of land under this crop. Here the tea gardens are scattered over small mounds called *teelas* or *bheels* or well drained flats along the river and its tributaries. Here rainfall is 300-400 cm and no month is completely dry.

West Bengal. West Bengal is the second largest producer contributing over 23 per cent of India's tea from about 22 per cent of the country's total area under tea cultivation. Entire tea of West Bengal is produced in three northern districts of Darjeeling, Jalpaiguri and Koch Bihar. These districts are contiguous to the main tea producing belt of Assam. Tea producing areas of West Bengal are divided into two geographical regions.

(*a*) ***The Duars*** in Koch Bihar and Jalpaiguri districts is a 16 km wide strip at the foot of the Himalayas. Here tea is raised on slightly elevated areas where suitable slope for proper drainage is available. Tea estates are found upto a height of 900-1,200 m.

(*b*) ***Darjeeling*** district is well known all over the world for its most exquisite aromatic tea. Annual rainfall of 300 cm; moderate temperature and fertile soils give special flavour to tea although yields are quite low, generally below 20 quintals/hectare. Tea estates are found within 900-1,800 m elevation beyond which the temperature is low and does not support tea cultivation. According to a study conducted by Tea Board in 2002, land under tea cultivation can be increased by more than 5 per cent. In some of the smaller gardens of Darjeeling, land under tea cultivation can be increased by about 22 per cent.

Some tea gardens are also found in Tripura, Arunachal Pradesh and Manipur in north-east India.

2. South India

In South India tea is produced in Nilgiri, Cardamom, Palni and Anaimalai hills in Tamil Nadu, Kerala and Karnataka states extending from 9°N to 14°N latitudes. This region accounts for 25 per cent production and about 44 per cent of area under tea in India. Tea gardens are mostly located on the hill slopes of the Western Ghats between 300 and 1,800 m altitude. The tea estates are quite large in number (*see* **Table 22.37**) but quite small in size. The temperatures are uniformally high and the annual rainfall exceeds 400 cm. There is no fear of frost in south India and weather conditions are quite congenial. Therefore, the productivity is higher, generally 15-25 quintals/hectare, although the quality of tea is inferior. But some of the south Indian teas have a good combination of taste and flavour.

In South India, **Tamil Nadu** is the largest producer of tea accounting for over 16 per cent of total tea production of India from over 14 per cent of the land. Nilgiri and Anaimalai produce 46 per cent and 33 per cent of Tamil Nadu's tea respectively. **Kerala** is another important producer of tea in South India accounting for 7.22 per cent of the total production of India. Kottayam, Kollam and Thiruvananthapuram are the main tea producing

districts. Some tea is produced in Hassan and Chikmaglur districts of **Karnataka**. This state has the distinction of giving the highest yield of over 25 quintals per hectare.

3. North West India

Some of tea is produced in Dehra Dun, Almora and Garhwal districts of Uttarakhand and in Kangra Valley and Mandi district of Hiamchal Pradesh. Green tea is produced in Kangra valley of Himachal Pradesh.

Tea in small quantity is also produced in Ranchi and Hazaribagh districts of Chota Nagpur plateau in Jharkhand.

Trade

Besides being the third largest producer, India is also one of the leading exporters of tea in the world. India had a long tradition of being the largest exporter of tea in the world, but her predominant position as an undisputed leader of tea exporting country has been severely shattered by fast increasing domestic consumption and by tough competition by some other tea exporting countries in the world market. Despite impressive increase in the production of tea from 0.4 million tonnes in 1970-71 to one million tonnes in 2013-14, our exports have been varying from 2.0 lakh tonnes to 2.6 lakh tonnes between 2008-09 and 2012-13.

In the year 2012-13, India exported 267.49 thousand tonnes of tea worth ₹ 4,677.8 crore.

Our present per capita consumption of about 0.6 kg is much lower than that of 0.8 kg in Australia, 0.9 kg in Japan, 1.0 kg in New Zealand, 1.5 kg in Ireland and 2.4 kg in United Kingdom. If our per capita consumption also increases along with the increase in population, for which there is a vast scope, we shall be left with very little surplus for export. Internal consumption of tea has already grown from a modest of 319 million kg in 1981 to a staggering 960 million kg in 2012-13.

Any attempt to increase production and thereby increase export after meeting the increasing domestic demand will largely involve new seeds and techniques of tea cultivation because prospects of acquiring virgin land for expanding tea plantations are extremely bleak. A study by the Tea Board in 2007 has revealed that 38 per cent of all tea bushes are over 50 years and another 90 per cent are in the age group of 40-50 years, and are not capable of giving high yields. There is urgent need to replace the old bushes with new plants. TV-29, a high yielding clone of tea was introduced in 1991. This seed gives four times as large as the average yield given by the conventional seeds and holds out great possibilities for increasing tea production in India. Old bushes giving low yields are likely to be replanted gradually with high yielding tea plants. In order to achieve this goal of meeting the growing demand in the home market and to produce surplus for export a plan for additional 5,000 hectares of new plantations in the non-traditional areas, replanting of 20,000 hectares of old bushes by new plants and rejuvenation of 40,000 hectares by irrigation, proper drainage and improved cultural practices has been chalked out. In 2007, a plan was approved for replantation of 1.71 lakh hectares and rejuvenation of 0.42 lakh hectares in 1600 estates. Forty six per cent of the total area to be replanted/rejuvenated falls in Assam, 28 per cent in West Bengal and 22 per cent in Tamil Nadu and other south Indian states.

In addition to the increasing domestic demand and dwindling exportable surpluses, India has to face tough competition from other tea exporting countries especially from Sri Lanka, China, Japan, Vietnam, Indonesia and some African countries like Kenya. India's share in the world market has come down

TABLE 22.38. Exports of Tea from India

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Quantity (Thousand tonnes)	182.8	177.77	183.4	162.86	185.63	197.39	207.46	207.53	238.34	292.35	267.49
Value (₹ crore)	1652.67	1637.35	1840.30	1730.73	1969.51	2034.17	2688.87	2943.53	3354.31	4078.53	4677.08

Source : Agricultural Statistics at a glance, (2012), pp. 248-49 and 2013 pp. 245-46.

TABLE 22.39. Imports of Tea by India

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Quantity (Thousand tonnes)	23.64	10.77	31.76	18.75	23.29	19.73	25.16	34.46	20.82	22.43	22.30
Value (₹ crore)	125.30	64.60	146.92	108.14	127.06	130.95	197.00	276.54	202.00	218.90	274.43

Source : Agricultural Statistics at a glance, (2012), pp. 245-46 and 2013, pp. 242-43.

from 45 per cent in 1950-51 to about 10 per cent in 2012-13. Exports from Sri Lanka occasionally surpass the exports from India. India exports tea to as many as 80 countries but Russia, U.K., the USA, Germany, Australia, Afghanistan, Ireland, Sudan, Iran, Iraq, Egypt, etc. are our main customers. U.K. is generally the chief buyer. A remarkable feature of export during 2002 was the sharp rise tea exports to Iraq, which had become the second largest (22 per cent) destination of Indian tea after Russia (24 per cent). Tea exports to West Asia—North Africa region jumped to 76 million kg in 2002, from 48 kg in 2001 mainly due to increased exports to Iraq under the 'Oil-for-Food Programme'. Pakistan imports about 140 million kg of tea annually and we export only eight million kg to our neighbouring country. Thus there is lot of scope to increase our tea exports to Pakistan. Kolkata is the chief port of tea export from India. The other major ports through which tea is exported are Chennai, Mangalore and Kochi.

Of late, some quality of tea is being imported for blending and re-exports. Large quantities of inferior quality tea are imported and re-exported, severely affecting India's quality image in the international market. **Table 22.39** shows the trends in tea imports by India.

Over 80 per cent of the imported tea was supplied by Vietnam, Indonesia and Sri Lanka. Vietnam was the largest source accounting for 55 per cent of the total imports. Taking a serious note of falling tea exports, the Government of India took several steps in 2004 to help tea growers in increasing the production and exports of tea.

COFFEE

Coffee is the second most important **beverage crop** of India next only to tea. It is indigenous to Abyssinia Plateau (Ethiopia) from where it was taken to Arabia in 11th century. From Arabia, its seeds were brought to India by Baba Budan in the 17th Century and were raised in the Baba Budan Hills of Karnataka. British planters took keen interest in coffee plantations and large coffee estates were established near Chikmagalur (Karnataka) in 1826, in Manantody (Waynad) and Shevoroys in 1830 and Nilgiris in 1839. Currently, there are over 52,000 coffee gardens giving employment to 2.5 million persons.

Conditions of Growth

Coffee plant requires hot and humid climate with temperature varying between 15°C and 28°C and rainfall from 150 to 250 cm. It does not tolerate frost, snowfall, high temperature above 30°C and strong sun shine and is generally grown under shady trees. Prolonged drought is also injurious to coffee. Dry weather is necessary at the time of ripening of the berries. Stagnant water is harmful and this crop is grown on hill slopes at elevations from 600 to 1,600 metres above sea level. Northern and eastern aspects of slopes are preferred as they are less exposed to strong afternoon sun and the south-west monsoon winds. Well drained, rich friable loams containing good deal of humus and minerals like iron and calcium are ideal for coffee cultivation. The soil must be properly manured to retain and replenish fertility and to increase productivity. Coffee cultivation requires plenty of cheap and skilled labour for various operations including sowing, transplanting, pruning, plucking, drying, grading and packing of coffee.

Production and Distribution

India produces about 3.5 per cent of world's coffee on almost the same percentage of coffee plantations. Thus India is an insignificant producer of coffee and stands nowhere when compared with Brazil (25%), Colombia (15%) and Indonesia (7%). However, India has progressed a lot in terms of absolute figures as is clear from **Table 22.40**.

TABLE 22.40. Production of Coffee in India

Year	1970-71	1980-81	1990-91	2000-01	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Area (Million/hectares)	0.1	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Production (Million tonnes)	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Yield (kg/hectare)	814	624	759	959	748	815	838	838	766	766

Source : Economic Survey 2013-14, Statistical Appendix, pp,. 17-19.

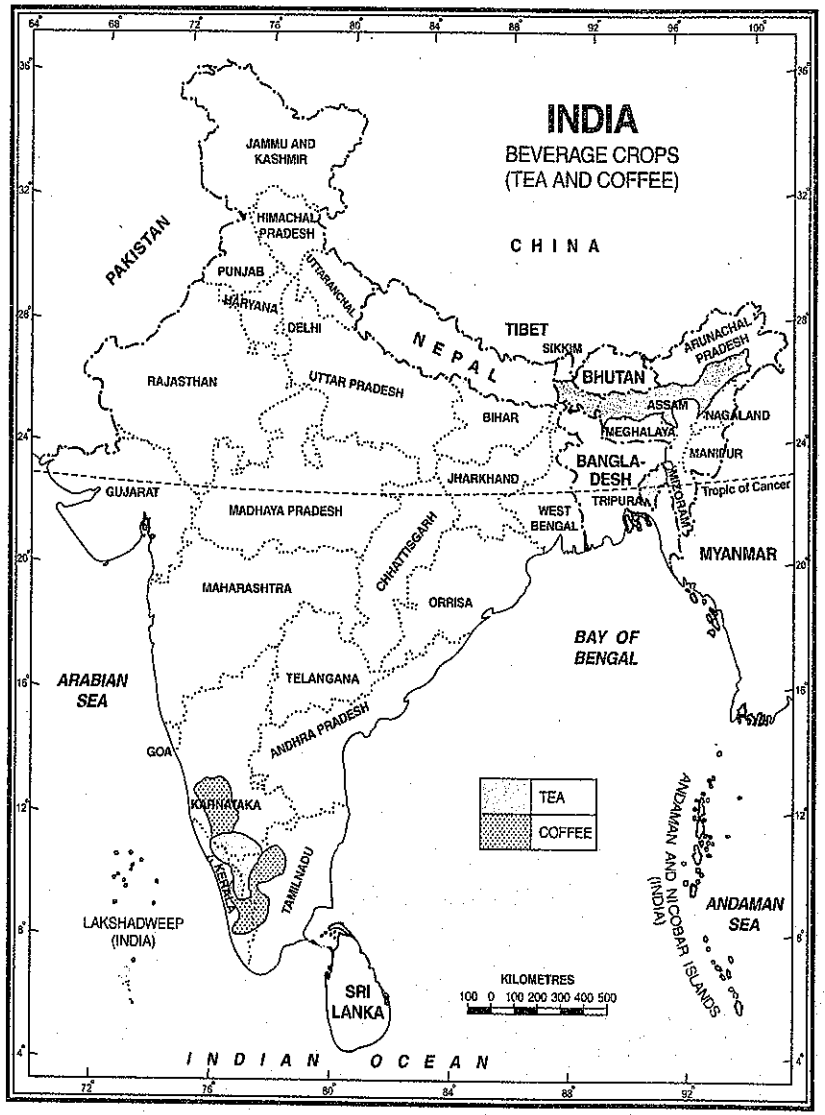

FIG. 22.6. India : Beverage Crops (Tea and Coffee)

Currently, India is the seventh largest producer of coffee in the world after Brazil, Vietnam, Colombia, Indonesia, Ethiopia, and Mexico.

Coffee Arabica and *Coffee Robusta* are the two main varieties of coffee grown in India accounting for 49 per cent and 51 per cent of area respectively under coffee.

The restricted agro-climatic conditions have forced the coffee plantations to confine themselves to small area in south India comprising hill areas around Nilgiris. Almost the entire production is shared by three states namely Karnataka, Kerala and Tamil Nadu.

Karnataka is the largest producer accounting for over 71 per cent of total coffee production and 59 per cent of the area under coffee in India. This state also gives the highest yield of 9.6 quintals/hectare. Most of the 4,650 plantations are at about 1,370 metres above sea level where annual rainfall is 125-150 cm. Kodagu and Chikmagalur account for over 80 per cent of the state's total output. The other important coffee producing districts are Shimoga, Hassan and Mysore. **Kerala** is the second largest producer of coffee but lags far behind, accounting only for about 22.27 per cent of the total production of the country. Its yield of 7.6 quintals/hectare is also low as compared to 9.6 quintals/hectare of Karnataka. Most of the coffee plantations are at an altitude of 1,200 m where annual rainfall is over 200 cm. Kozhikode, Waynad, Malappuram, Kollam, Kannur and Palakkad are the chief producing districts. **Tamil Nadu** is the third largest producer where India's 6.5 per cent coffee is produced. About half of Tamil Nadu's coffee is produced in Nilgiri district. The other districts are Madurai, Tirunelveli, Salem and Coimbatore.

Some coffee is also grown in Satara and Ratnagiri districts of Maharashtra. In line with the national policy of tribal development, coffee cultivation is being encouraged in such non-traditional areas as Andhra Pradesh, Odisha, Maharashtra, the north-eastern states and Andaman and Nicobar Islands.

Trade

Among the plantation crops, coffee has made significant contribution to the Indian economy during the last 50 years. Although India contributes only a small per cent of the world production, Indian coffee has created a niche for itself in the international market, particularly Indian Rebustas, which are highly preferred for their good blending quality. Arabic coffee is also well received in the international market. In short Indian coffee is well known for its quality and is much in demand in the international market. Therefore, India exports coffee to a large number of countries including U.K., the U.S.A., Russia, Australia, Iraq and a large number of countries of continental Europe. Chennai, Mangalore and Kozhikode are the chief ports of export. Indian coffee exports have registered significant increase, both in terms of quantity and earnings during the last few years (*see* **Table 22.41**). In 2011-12 India exported 278.94 thousand tonnes of coffee which was two-thirds of the total production. The total earnings from the export of coffee in that year amounted to ₹ 4,533.31 crore.

RUBBER

Rubber is a coherent elastic solid obtained from latex of a number of tropical trees of which *Hevea brasiliensis* is the most important. Rubber is used for a variety of purposes from erasing pencil marks to manufacturing of tyres, tubes and a large number of industrial products. The first rubber plantations in India were set up in 1895 on the hill slopes of Kerala.

TABLE 22.41. Export of Coffee from India

Year	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Quantity ('000 tonnes)	184.87	188.44	167.55	177.68	213.65	178.30	174.08	157.41	232.63	278.94
Value (₹ Crore)	993.98	1,085.92	1,069.08	1,588.69	1,969.00	1,872.27	2,255.76	2,032.06	3,009.91	4,533.31

Source : Agricultural Statistics at a glance, 2012, pp. 247-248.

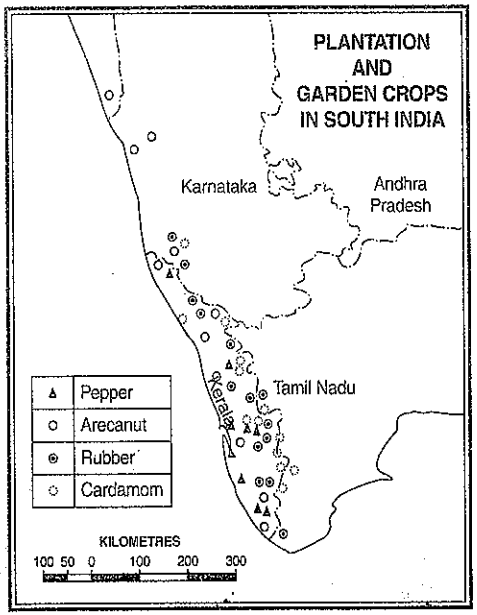

FIG. 22.7. Plantation and Garden Crops in South India.

However, rubber cultivation on a commercial scale was introduced in 1902.

Conditions of Growth

Rubber tree (*Hevea brasiliensis*) is a quick growing tall tree acquiring 20-30 metre height. It begins to yield latex in 5-7 years after planting. It requires hot and humid climate with temperature of 25°-35°C and annual rainfall of over 200 cm. The rainfall should be well distributed throughout the year. Dry spell, and low temperatures are harmful. Daily rainfall followed by strong sun is very useful. Deep well drained loamy soils on the hill slopes at elevation ranging from 300 to 450 metres above sea level provide best conditions for its growth. The yields decline at higher elevations and no rubber plantations are found above 700 m elevation.

Production and Distribution

India is the third largest natural rubber producing country of the world, next to Thailand and Indonesia, producing about 9 per cent of the global output. From about 200 hectares in 1902-03, the total area under rubber plantations increased to about 0.7 million hectares in 2013-14. Similarly, the production that was 80 tonnes in 1910 increased to about 0.9 million tonnes in 2013-14. The most important and noteworthy achievement has been the increase in productivity from 653 kg/hectare in 1970-71 to 1,206 kg/hectare in 2013-14 (*see* **Table 22.42**).

Though the rubber plantation sector was dominated by large estates during the initial five decades, it has subsequently undergone important structural transformation leading to dominance of small holdings. Today small holdings account for 88 per cent of area and production of rubber in India. The average size of small holding is 0.49 hectares only. However, the average productivity realised by small holders is much higher than that produced by the estates. **Table 22.42** gives the production trends of rubber in India. This table shows that India has made phenomenal progress in all the three aspects of rubber *i.e.* production, area and yields.

Almost entire rubber is produced in Kerala, Tamil Nadu and Karnataka.

Kerala is the largest producer of natural rubber producing 92 per cent of total rubber production of India. Kottayam, Kollam, Ernakulam, Kozhikode districts produce practically all the rubber of this state. **Tamil Nadu** is the second largest producer of rubber but lags far behind Kerala producing only 3 per cent of the total Indian production. Nilgiri,

TABLE 22.42. Production of Rubber in India

Year	1970-71	1980-81	1990-91	2000-01	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Area (Million hectares)	0.2	0.3	0.5	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Production (Million tonnes)	0.1	0.2	0.3	0.6	0.8	0.9	0.8	0.8	0.8	0.9	0.9
Yield (kg/hectare)	653	788	1076	1576	1299	1306	1211	1211	1211	1206	1206

Source : Economic Survey 2013-14. Statistical Appendix pp. 17-19.

Madurai, Kanniyakumari, Coimbatore and Salem are the chief rubber producing districts of Tamil Nadu. **Karnataka** produces less than 2 per cent of total Indian production. Chikmagalur and Kodagu are the main producing districts. Tripura is the fourth largest producer but contributes less than 2% of India's rubber. Andaman & Nicobar Islands also produce small quantities of rubber.

Trade

In India, consumption of rubber is almost always higher than the production and the production-consumption gap is likely to widen as the rate of consumption is faster than that of production. The per capita consumption of rubber in India is less than one kg as against 14 kg in the developed countries. This calls for larger quantities of import of both natural and synthetic rubber.

Considering the long-term requirements of natural rubber in the country, the Rubber Board of India has conducted exploratory surveys and has identified North Eastern region, parts of West Bengal, Odisha, Maharashtra and Karnataka as potential regions of rubber cultivation. Rubber can be grown in an area of 1.2 million hectares with appropriate refinements in agro-management practices in these regions. In the North-Eastern regions about 4.5 lakh hectares of land can be brought under rubber plantations.

SPICES

India has a glorious past, pleasant present and a bright future with respect to production and export of spices. Pepper, cardamom, chillies, turmeric and ginger are some of the important spices produced in India. India is a great exporter of spices. During the past few years, there has been a steady increase in area and production of spices in India. The annual growth rate in area and production of spices is estimated to be 3.6 and 5.6 per cent respectively.

PEPPER

Among the spices, black pepper, "the king of spices" is the most important dollar earning crop which has a decisive role in our national and state economies. It is an important spice which is used for flavouring foodstuffs. It is a tropical plant which requires a minimum of 10°C and maximum of 30°C temperature. A well distributed rainfall of 200-300 cm helps its growth. The plant grows as a vine and needs support of other trees for its growth. It thrives well on deep, friable, well drained loamy soils, overlaying the lateritic hill tops of Western Ghats, though it can also be grown on red and laterite soils. It can be grown well from almost sea level to an altitude of 1,200 m but the coastal sandy plains are not much suited for its growth.

Production and Distribution

India is the second largest producer of pepper in the world after Indonesia. Varying trends have been observed with respect to area, production and yields of pepper depending on the weather conditions. These variations become obvious when we look at **table 22.43**.

Its distribution is highly concentrated in Kerala, Karantaka and Tamil Nadu. **Kerala** produces 60 thousand tonnes (94% of India) of pepper. Though it is produced in almost all the districts of Kerala, the largest production comes from Kannur district, followed by Kottayam, Thiruvananthapuram, Kollam, Kozhikode and Ernakulam. **Karnataka** is a distant second contributing only 3 per cent of the total

TABLE 22.43. Production of Pepper in India

Year	1997-98	2000-01	2004-05	2005-06	2007-08	2008-09	2009-10	2010-11	2011-12	2011-12	2012-13
Area (thousand hectares)	181.5	213.9	228.3	260.2	246.0	197.0	238.7	195.9	184.0	200.3	124.6
Production (thousand tonnes)	57.3	63.7	73.0	92.9	69.0	47.1	47.4	51.0	52.0	42.6	52.6
Yield (kg/hectare)	318	298	320	357	281	239	199	260	183	203	422

Source : Agricultural Statistics at a glance, 2013, p. 194.

production of India. Kodagu and Uttar Kannad are the major contributing districts. **Tamil Nadu** also produces small quantity of pepper.

About one-third of total production of pepper finds its way to the foreign markets. India exports pepper to as many as 80 countries. The Russian Federation, the USA, Canada, East and South European countries, Sudan and Egypt are the main buyers. However, India's hitherto unquestioned status throughout history as the largest producer and exporter of black pepper in the world is now under threat with preliminary forecast on production and export data from Vietnam. India has to face this challenge to maintain her supremacy with respect to exports of pepper.

CARDAMOM

Cardamom is known as the 'queen of aromatic spices' and is mainly used for masticatory, flavouring and for medicines. It grows well in climate of high heat and humidity with temperature ranging between 15°C and 32°C and a fairly distributed annual rainfall of 150-300 cm. Well drained forest loams, deep red and laterite soils with plenty of humus and leaf mould are some of the soils which are ideally suited to its successful growth. Tropical rain forests at an altitude of 800-1,600 metres above sea level provide the most congenial environment for its growth. It is a shade loving plant and is grown under shady trees.

Production and distribution

India produces a major part of the world's total cardamom. The production and productivity of cardamom in India have increased in spite of decrease in cardamom area from 94.3 thousand hectares in 1997 to 92.4 thousand hectares in 2012-13. The production of cardamom in India was 18.4 thousand tonnes in 2012-13. Demand for cardamom is increasing in the world market. To meet this demand the productivity will have to be increased from the present level of 199 kg/ha to 250 kg/ha.

The entire production comes from three states *viz*., Kerala, Karnataka and Tamil Nadu and these states contribute 53, 42 and 5 per cent respectively of the total production of India. (*see* **Fig. 22.7**). In **Kerala**, the crop is largely concentrated in the Cardamom hills, Idukki, Palakkad (Palghat), Kozhikode and Kannur are the leading producing districts. In **Karnataka** the main producing districts are Kodagu, Hassan, Chikmagalur, Uttara and Dakshin Kannad. Madurai is the most outstanding district of **Tamil Nadu.** This is followed by Salem, Coimbatore, Ramnathpuram, the Nilgiris and Tirunelveli.

About half of the total production is exported. More than 60 countries buy our cardamom but our major customers are Saudi Arabia, Russia, U.K., Germany, Sweden, Finland, Kuwait, Afghanistan and Bahrain. India enjoyed near monopoly in area, production and export of cardamom upto early 1980s. As Guatemala stepped up its production from mid-1980s, India was relegated to second position in productivity and export of cardamom. India needs to boost up its production to regain the lost eminence of cardamom trade. Presently Guatemala has emerged as the top producer and exporter of cardamom sharing 90 per cent of the world export of cardamom.

Chillies

Chilli is another important spice produced in India. It requires temperatures ranging from 10° to 30°C and moderate annual rainfall of 60 to 125 cm

TABLE 22.44. Production of Cardomom in India

Year	1997-98	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Area (thousand hectares)	94.3	92.4	95.8	98.2	81.8	92.0	90.2	87.0	89.0	92.4
Production (thousand tonnes)	11.7	14.5	17.8	15.7	13.4	15.5	15.7	16.0	15.8	18.4
Yield (kg/hectare)	123	157	186	160	164	168	174	184	178	199

Source : Agricultural Statistics at a glance, 2013, p. 198.

TABLE 22.45. Production of Chilli in India

Year	1997-98	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Area (thousand hectares)	840.6	836.5	654.0	763.2	805.8	779.1	767.2	792.0	792.0	794.1
Production (thousand tonnes)	870.1	983.3	1,014.6	1,242.1	1,297.9	1,269.9	1,202.9	1,223.0	1,260.0	1,304.4
Yield (kg/hectare)	1,035	1,176	1,551	1,627	1,611	1,630	1,568	1,544	1,591	1,643

Source : Agricultural Statistics at a glance, 2012, p. 192.

Too scarce or too heavy rainfall is harmful. It can be grown on a wide variety of soils including black cotton soil, and different types of loamy soils. It can be grown upto elevations of 1,700 metres.

The production of chillies has almost trebled from 351 thousand tonnes in 1997-98 to 1,304 thousand tonnes in 2012-13.. The yield per hectare had also increased by about 1.5 times from 1.76 kg in 2000-01 to 1,643 kg in 2012-13. Although all states of India produce some quantity of chillies, **Andhra Pradesh** with 50 per cent of the all India production was the largest producer in 2012-13. Guntur, East Godawari and West Godavari, Prakasam are the main chilli producing districts. Warangal, Khammom and Karimnagar are the main chilli producing districts in **Telangana. Maharashtra** and **Odisha** produce equal amount of chilli, although way behind Andhra Pradesh. The other major producers were Rajasthan, West Bengal, Karnataka, Tamil Nadu, Gujarat, Uttar Pradesh, Madhya Pradesh and Assam.

Most of the chillies produced in India are consumed within the country and only 5 to 7 per cent are exported, mainly to Sri Lanka, the USA and Russia.

Ginger

Ginger is used both as a spice and for making medicines. It is grown in tropical and sub-tropical climates and requires 10° to 25°C temperature and 125-250 cm rainfall. Well drained sandy, clayey or red loams and laterites are best suited soils for its cultivation. It can be grown from sea level to an altitude of 1,300 m above sea level.

India is the largest producer of ginger in the world producing about 80 per cent of the world production. The production of ginger has increased from 252.1 thousand tonnes in 1997-98 to 682.6 thousand tonnes in 2012-13. The area occupied by this crop also increased considerably from 75.6 thousand hectares in 1997 to 136.3 thousand hectares in 2012-13. A corresponding increase in yield per hectare has also been recorded from 3,335 kg in 1997-98 to 5,010 kg in 2012-13. This shows the overall progress made by this crop. (**Table 22.46**).

TABLE 22.46. Production of Ginger in India

Year	1997-98	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Area (thousand hectares)	75.6	86.2	110.6	106.1	104.1	108.6	107.5	149.0	155.1	136.3
Production (thousand tonnes)	252.1	288.0	391.2	393.4	382.6	380.1	385.3	702.0	755.6	682.6
Yield (kg/hectare)	3,335	3,341	3,537	3,708	3,676	3,499	3,583	4,717	4,873	5,010

Source : Agricultural Statistics at a glance, 2013, p. 194.

Meghalaya, Andhra Pradesh, Kerala, Sikkim, Odisha, Mizoram, Karnataka etc. are the main producers.

About 80-90 per cent of the total production of ginger is consumed within the country and still India is a major exporter of ginger in the international market and accounts for about half of the total world trade. About 80 per cent of our exports go to the West Asian countries.

Turmeric

Turmeric is the native of the tropical lands of South-East Asia. It is an important condiment and is used in dyes and medicines also. It requires tropical climate and well drained sandy and clayey loams, medium black, red or alluvial soils for its growth.

India is an important producer of turmeric in the world. The production almost doubled from 549 thousand tonnes in 1997-98 to 1,062.5 tonnes in 2011-12. The area under turmeric also increased from 139.7 thousand hectares in 1997-93 to 199 thousand hectares in 2011-12. The yield per hectare did not lag behind and increased from 3,931 kg in 1997-98 to 5,340 kg in 2011-12.

Andhra Pradesh is the largest producer, producing about half of the total production of India. Guntur and Cuddapah districts account for two-thirds of the state's total production. Second place is occupied by **Tamil Nadu,** which produces more than 12 per cent turmeric of the country. Coimbatore accounts for 60 per cent of the state's production. **Karnataka** is the third largest producer accounting for 10.5% of the total production. Mysore and Belgaum are the outstanding producers. **Odisha** produces 9.7% where Phulabani and Koraput are the main producing districts. The other producers are *Gujarat*, *West Bengal*, *Maharashtra*, *Bihar*, *Assam* and *Tripura*.

About 90 per cent of the total production is consumed within the country and only 10 per cent is exported. The leading buyers of Indian turmeric are the USA, Russia, Japan, Sri Lanka and Singapore.

Arecanut

It is a hard nut which is cut into small pieces and used for chewing with betel leaves, lime and catechu. It is also used in Hindu religious ceremonies. Its stem is used for construction purposes and leaves for thatching.

Areca is a tropical tree which, on maturity, attains a height of 20-25 metres. It flourishes well in areas having 15° to 35°C temperature and 200-300 cm annual rainfall. It grows on a variety of soils ranging from well-drained laterite, red loamy to alluvial soils. Its cultivation can be done from sea level to 1,000 metres.

India is the largest producer of arecanut in the world. In the year 2012-13 India produced 6 lakh tonnes of arecanut from 4.5 lakh hectares of land. About 40 lakh people who are engaged in cultivating, curing, processing and trading of arecanut earn their livelihood from this nut. Kerala, Karnataka, Tripura, Assam and Meghalya are the major producing states accounting for about 90 per cent of the total output of India. **Kerala** is the largest producer accounting for 37 per cent of the Indian production. Kannur, Malappuram, Kollam, Kozhikode and Thrissur are the main producing districts of Kerala. In **Karantaka,** it is grown in Dakshina Kannada, Uttar Kannada, Chickmagalur, Shimoga and Tumkur districts. **Assam** produces about one-fourth of India's arecanut where Kamrup, Sibsagar and Darrang districts are important producers. Ratnagiri and Kolaba districts of **Maharashtra,** Coimbatore and Salem districts of **Tamil Nadu** are other important producers. West Bengal, Andhra Pradesh, Goa and Pondicherry also produce some arecanut.

Most of the arecanut is consumed within the country especially in the south Indian states and only a small quantity is exported mainly to Nepal, UAR, Pakistan, Saudi Arabia, Aman, Kenya and Singapore.

Coconut

Coconut palm is a very useful tree which gives us several items of every day use. Coconut is used for the manufacturing of ***copra*** which gives us oil. This oil is used for cooking and for several other purposes. The tree trunk gives timber and the shells of the nut are used as fuel. Leaves are used for various purposes such as making of mats, baskets, screens, etc. and for roofing the huts. Juice of green nuts serves as a sweet drink. *Gur*, sugar, *toddy* and vinegar are made from the juice collected from coconut spaths. Coconut oil-cake serves as food for poor people and is also fed to

cattle. Being a perennial crop, coconut has distinct features such as long period of economic life span of more than 60 years and long gestation period of 5-7 years.

Coconut is a tropical crop and is grown where temperature is 25° to 30°C and a fairly well distributed annual rainfall of 125 to 130 cm. In a few places, especially in Odisha, coconut is grown with as little as 100 cm annual rainfall. Frost and drought are very harmful to coconut. It is predominantly grown under rainfed condition in Kerala and parts of coastal Karnataka and Tamil Nadu. In rest of the country it is mainly grown under irrigation. Well drained rich loamy soils are best suited for its cultivation. It grows well on sandy loams along sea-coasts and in adjoining river valleys.

India is the third largest coconut producing country of the world next to Philippines and Indonesia. It is an important plantation crop grown in an area of 2.14 million hectares mainly in four southern states, *viz.*, Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. Small and marginal farmers (with an average holding size of less than 0.20 ha in Kerala and 2 ha in other three states) predominate coconut production sector in the country. Production of coconut increased from 35.82 hundred million nuts in 1950-51 to 226.84 hundred million nuts in 2012-13. The area under coconut also increased from 0.62 million hectare in 1950-51 to 2.14 million hectares in 2012-13. **Kerala** is the largest producer accounting for 26.6% of the total production of India in 2012-13. Though coconut is grown throughout the state, largest production comes from Thrissur, Ernakulam, Kollam, Thiruvananthapuram, Alappuzha, Kannur, Kottayam and Malappuram districts. These districts produce more than three-fourths of the total production of Kerala. Next is **Tamil Nadu** producing about one-fifth of the total production of India. Though every district of Tamil Nadu produces some quantity of coconut, over half the production of the state comes from Thanjavur, Coimbatore and Salem districts. **Karnataka** is the third largest producer accounting for 12 per cent of the total production of the country. About 80 per cent of Karnataka's coconut is produced by Uttara Kannada, Dakshina Kannada, Tumkur, Hassan, Chikmagalur and Chitradurg districts. **Andhra Pradesh's** 80 thousand tonnes mainly come from East Godavari, West Godavari and Srikakulam districts. The other producers are *West Bengal*, *Odisha*, *Maharashtra*, *Goa*, *Assam*, *Andaman and Nicobar Islands*, *Lakshadweep and Pondicherry*.

The export of coconut products indicate that India has done well in coir and coir products, while in the export of other coconut based products, its share is very negligible compared to other coconut growing countries of the world. However, the export of coconut products showed considerable increase from 1990-91 to 2013-14. The global demand for coconut and coconut products has increased considerably. It is estimated that 9 per cent increase per annum for fresh coconuts, 45 per cent increase for coconut milk, 45 per cent for activated carbon, eight-fold increase for coir products and 100 per cent increase in coir dust will be recorded in the next 5 to 10 years.

HORTICULTURE

The importance of horticulture in improving the productivity of land, generating employment, improving economic condition of the farmers and entrepreneurs, enhancing exports and, above all providing nutritional security to the people is widely acknowledged. Horticulture sector, which includes fruits, vegetables, spices, floriculture and coconut, among others covered 23.7 million hectares of land in 2012-13. The horticulture sector contributed about 30 per cent of GDP from agriculture in 2011-12. In 2011-12, India accounted for about 10 per cent of the global production of fruits and was the second largest producer of fruits in the world. Immense agro-climatic diversity enables India to grow a large variety of horticulture crops. The country holds first position in global production of bananas, mangoes and cashew and is among the first ten in citrus, pineapple and apple production. India holds first position in global production of cauliflower, second in onion, third in cabbage and is among the top ten in production of potato, tomato, onion and green peas.

Cashewnut

Cashew tree is grown for cashewnut and cashew apple. Cashew kernel is used as a dry fruit delicacy. It is extracted from the nut by roasting, shelling and peeling. The oil drawn from the shell is used for manufacturing paints and varnishes. Juice from the

cashew apple is used for making syrup, jam, squash and wine.

Cashew requires average temperature between 16°C and 25°C and a wide range of rainfall from 50 to 350 cm. It can be easily grown on poor rocky soils. It grows well on laterite soils on the west coast and on sandy soils on the east coast. The average yield of cashew kernel varies from 110 to 220 kg/hectare.

Cashew plantations were introduced in India by the Portuguese on the western coast of the country during 16th and 17th centuries. At present, India holds first position in the world in the production of cashew and it is now widely grown on western and eastern coasts. In 2012-13, India produced 7.53 lakh tonnes of cashew from 9.92 lakh hectares of land. In 2012-13, Maharashtra (29.9%), Andhra Pradesh

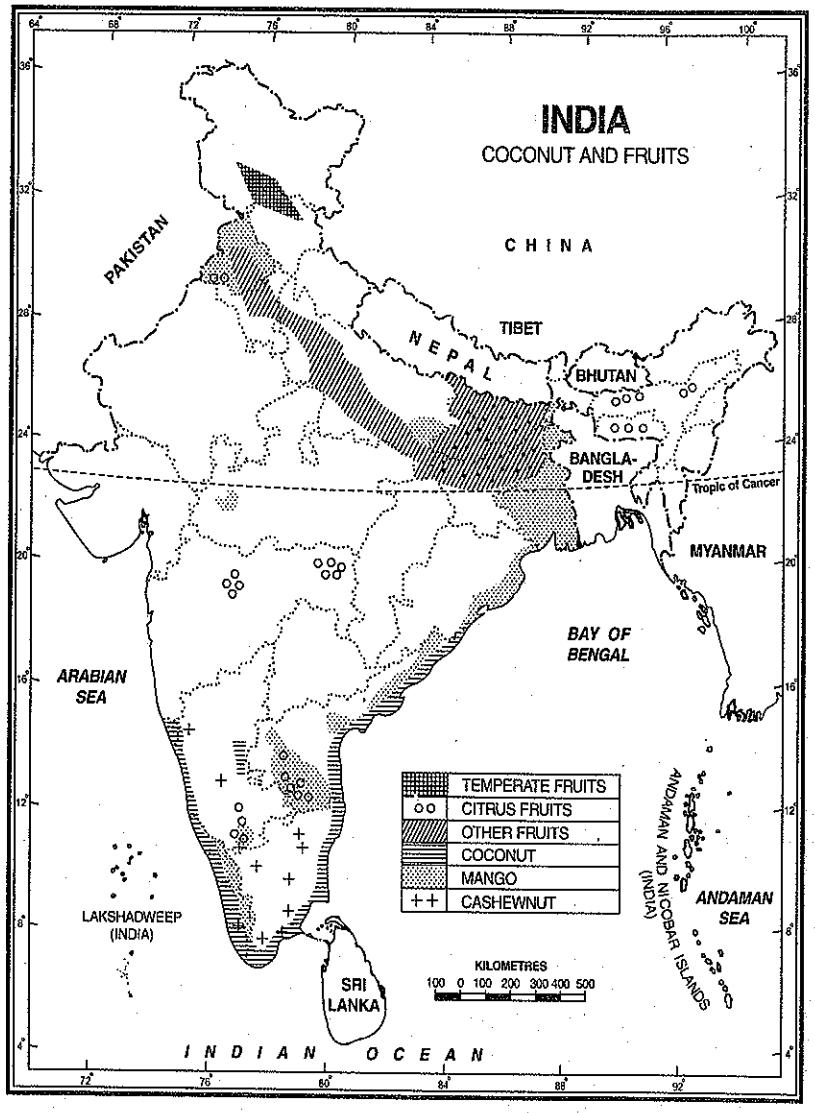

FIG. 22.8. India : Coconut and Fruits

(15.7%), Odisha (13.4%), Kerala (10.2%), Karnataka (9.9%) and Tamil Nadu (8.2%) were the major producers of cashewnut. The other producers were Goa, West Bengal and Jharkhand.

India is the largest exporter of cashewnut kernel in the world. She meets about 90 per cent of the world demand of cashewnuts. In 2012-13, India exported 299.52 thousand tonnes of cashew kernel valued at ₹2,881.55 crore. India exports cashew kernel to about 50 countries, the chief among which are the U.S.A., Russia, the U.K., Germany, Canada, Australia, the Netherlands, Malaysia and Japan.

Mango

Mango is the native of monsoon lands and is grown in areas with temperature from 20°C to 30°C and rainfall 75 to 250 cm. It can grow in almost all soils of India but prefers rich clayey loams. It is largely grown in groves especially near towns and villages where it has a ready market.

India is the largest producer where about 1,000 varieties of mango are grown. The main varieties are *dashari*, *langda*, *chausa*, *sapheda*, *fajli*, *malda*, *mohanbhog alfonso* and *shahpasand*. Mango occupied an area of around 2.5 million hectares and the annual production was about 18 million tonnes in 2012-13. India contributes over 54% of world production of mango. Uttar Pradesh, Bihar, Andhra Pradesh, West Bengal, Odisha, Kerala, Tamil Nadu, Maharashtra, Gujarat and Karnataka are its main producers.

Most of the mango produced is consumed within the country as a delicious fruit and for making pickles, *chutneys* and squashes. Even then, India is the largest exporter of mango in the world. Major importers of Indian mango are Bangladesh (33.76%), UAE (27.21%), Saudi Arabia (6.83%) and U.K. (4.95%).

Apple

Apple is a temperate fruit crop. It requires average temperature from 21° to 24°C during the active growing season. For optimum growth, 100-125 cm rainfall, well-distributed throughout the growing season is considered most favourable. The orchard localities should be free from hail storms and frost. Low temperature, rain, fog and cloudy weather hampers its proper growth at the time of maturity. These conditions are found on hill slopes at altitudes ranging from 1,500-2,700 m above mean sea level.

Loamy soils, rich in organic matter and having good drainage are most suitable for apple cultivation. Soil should be free from hard substrata and waterlogging.

In most areas apple orchards have replaced millet crop which is a low value crop. This has raised the income levels and standard of living of the farmers. In addition it has generated employment in processing, packing and transporting apples.

Apple is a nutritive fruit and is in great demand throughout the country, particularly in urban markets. At the same time, it is a perishable commodity and has to be brought to the market as early as possible. This requires quick and efficient means of transport.

The main areas of apple production are Kullu and Shimla districts in Himachal Pradesh, the Kashmir Valley and hilly areas of Uttarakhand.

Banana

Banana is primarily a tropical and sub-tropical crop, requiring average temperature of 20° to 30°C throughout in growth period. The rainfall should be fairly above 150 cm. The banana tree grows well in rich, well drained soil with ample moisture and humus.

India is the largest producer of banana in the world. Banana ranks third in area covering 12.46% of the total fruit area but first in total production accounting for over one-third of total fruit production. The production more than doubled from 12,642.5 thousand tonnes in 1997-98 to 26,646.5 thousand tonnes in 2011-12. Although banana growing is spread all over India, peninsular India provides ideal conditions for its cultivation. Tamil Nadu and Maharashtra are two main producers accounting for about half of total banana produced in India. The other producers are Gujarat, Karnataka, Kerala, Andhra Pradesh and Assam. Most of banana is produced on a small scale under different production systems. Some banana is exported. The main destination of banana export is the UAE.

Orange

Orange is the most important citrus fruit which is widely grown both in north and south India. Soil

seems to be important factor for orange than climate. Most of orange orchards are rainfed and are located at heights from 600 to 1,500 m. Well-drained, even textured sandy loams which permit root penetration upto 2-4 metres are best for orange cultivation.

Although orange is grown in almost all the states, its cultivation is more prominently concentrated in the hilly region of Uttarakhand, Kangra valley of Himachal Pradesh, Darjeeling in W. Bengal, Khasi and Jaintia Hills in Meghalaya. Hyderabad in Telangana, Kodagu district of Karnataka, Waynad district of Kerala, Nilgiri district of Tamil Nadu and Nagpur and Pune districts of Maharashtra.

Grape

Grape is a sub-tropical plant and requires long summer, short winter, a moderately fertile well drained soil, relatively low water supply during the growing period and a bright sunshine during the three months in which the fruit matures. In northern India, the plant gives only one crop during summer but in south India the plant grows throughout the year and yields two crops a year, one in March-April and the other in August-September.

Grapes can be grown any where in India but there are certain areas where this fruit is grown more intensively. Among the major producing states are Uttarakhand, Himachal Pradesh, Jammu and Kashmir and Punjab in the north and Maharashtra, Andhra Pradesh, Telangana, Tamil Nadu and Karnataka in the south. Some grape is exported. The main export destinations for grape are Bangladesh, the Netherlands, U.K. and U.A.E.

Peach

Peach is more of a luxary than apple, due to its more perishable nature. It grows well in temperate climate. The main areas of peach cultivation are in Himachal Pradesh, Uttarakhand and Kashmir Valley. It cannot be transported over long distances due to its highly perishable nature and is primarily used in local market. However, some peach is carried over long distances at heavy transportation costs.

Pear

Pear is another temperate fruit, mainly grown in Kashmir, Kumaon region of Uttarakhand and Himachal Pradesh in the north and the Nilgiri hills in the south. These areas offer suitable conditions of cold winters, cool summers, moderate rainfall, high percentage of cloudiness and mist.

Apricot

Apricot is also a temperate fruit which requires 130 to 200 cm rainfall, moderate temperatures and humid nights. It requires cool weather with abundant moisture during early parts and moderately high temperature during the later part of its growth. It is mainly grown in Kashmir valley, Himachal Pradesh and Kumaon region of Uttarakhand.

Strawberry

Strawberry requires above 16°C temperature during its growing season and a lot of water because strawberry fields are submerged under 10 cm of fresh and slowly moving water for atleast three months. Any fertile soil which can retain water for a sufficiently long time is suitable for its cultivation but sandy loams are best suited for it. The hilly areas of J & K., H.P. and Uttarakhand are the main producers. Jeolikote in Nainital district is the largest producer of strawberry, producing nearly all the canned strawberries.

Almond and walnut are two other temperate fruits grown mainly in the Kashmir Valley, Himachal Pradesh and Kumaon-Garhwal region of Uttarakhand.

VEGETABLES

India also grows a large variety of vegetables. With growing population, health care and urbanization, demand for vegetables has increased considerably after Independence. With 100 million tonnes of annual production of vegetables, India ranks as the highest producer of vegetables in the world. Most of the vegetables are short duration crops as a result of which two to three crops are raised from the same piece of land in one year. Since, different vegetables are grown in different seasons, the process of vegetable cultivation continues throughout the year. Most of the vegetables are grown around urban areas where they find ready market for their sale. A strong vegetable sector in India will lead to economic growth throughout the country. Cultivating vegetables provides more jobs compared to cereal production. It will diversify and generate farm income larger than other products. India grows an amazing number of different vegetables—175 different types in all—but potato, tomato, onion, cabbage and cauliflower account for 60 per cent of the total production. The other important vegetables are cucumber, carrot, brinjal, mushroom, coloquintida, pumpkin, gourd, and many more. It is projected that the domestic vegetable requirements will increase from current level of 83-91 million tonnes to 151-183 million tonnes in 2030. This demand will have to be fulfilled by increasing home production or by resorting to imports.

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Mineral Resources

MINERALS AND MINING

Minerals are closely associated with mining. Mining and quarrying covers underground and surface mines, quarries and wells and includes extraction of minerals and also all supplemental activities such as dressing and benefication of ores and other crude materials, like crushing, screening, washing, cleaning, grading and several other preparations carried out at the mine site, which are needed to render the material marketable. *Open cast mining* and *underground mining* are two chief methods of mining practised in India. Open cast mining is more useful for minerals found just below the surface while underground mining is done to extract minerals found at greater depths. Drilling and pumping is practised for extracting oil and natural gas.

MINERAL WEALTH OF INDIA

India is endowed with a rich variety of minerals. Large size and diverse geological formations have favoured India in providing a wide variety of minerals. According to **Meher D.N. Wadia**, "The mineral wealth of India, though by no means inexhaustible, is varied enough to provide for sound economic and industrial development of the country but has at the same time, certain important deficiencies. It has been estimated that nearly 100 minerals are known to be produced or worked in India, of which nearly 30 may be considered more important including several which although comparatively unimportant in quantity today are capable of material development in future with expansion of industries. The country has fairly abundant reserves of coal, iron and mica, adequate supplies of manganese ore, titanium and aluminium, raw materials for refractories and limestone; but there is a deficiency in ores of copper, lead and zinc. There are workable deposits of tin and nickel." India earns a lot of foreign exchange by exporting a large variety of minerals such as iron ore, titanium, manganese, bauxite, granite and a host of other minerals. At the same time India has to depend upon imports to meet her requirements of some other minerals such as copper, silver, nickel, cobalt, zinc, lead, tin, mercury, limestone, platinum, graphite and so many other minerals.

DISTRIBUTION OF MINERALS AND MINERAL BELTS

The most striking feature of the Indian minerals is their uneven distribution. Some areas are very rich in minerals while some others are completely devoid of this valuable asset. The high rainfall areas of India lack in limestone, gypsum and salts which are soluble. The northern plains of India have thick layers of alluvium which has completely concealed the bedrocks. This region of the country is poor in mineral resources. The Himalayas have a variety of rocks but its geological structure is too complex. The exploitation of minerals in this mountainous terrain is not economically viable not only due to small quantity available at any one location but also due to difficult terrain, lack of transportation, sparse population and adverse climatic conditions. It is, thus, evident that our rich mineralised zone with relatively sizeable quantities is confined to the old, crystalline rock structures of plateaus and low hills of peninsular India. This has resulted in the emergence of well defined mineral belts which are briefly described as under :

1. The North-Eastern Peninsular Belt. This belt comprising of Chhota Nagpur plateau, and Odisha Plateau in the states of Jharkhand, West Bengal and Odisha is the richest mineral belt of India. It contains large quantities of coal, iron ore, manganese, mica, bauxite, copper, kyanite, chromite, beryl, apatite and many more minerals. In fact you ask for any major mineral of India and you will find it in this belt. Thus it is a mineral region *par excellence*. The Chota Nagpur plateau is known as the *mineral heart land* of India. According to **Wadia**, this region possesses India's 100 per cent Kyanite, 93 per cent iron ore, 84 per cent coal, 70 per cent chromite, 70 per cent mica, 50 per cent fire clay, 45 per cent asbestos, 45 per cent china clay, 20 per cent limestone and 10 per cent manganese. However, many changes have taken place in the recent years.

2. Central Belt. This belt encompassing parts of Chhattisgarh, Madhya Pradesh, Telangana, Andhra Pradesh and Maharashtra is the second largest mineral belt of India. Large deposits of manganese, bauxite, limestone, marble, coal, gems (panna), mica, iron ore, graphite, etc. are available here. A comprehensive geological survey is still needed to know about the mineral wealth of this belt.

3. The Southern Belt. It covers mostly the Karnataka plateau but extends over the contiguous Tamil Nadu upland. It is more or less similar to the north-eastern peninsular belt, as far as deposits of ferrous minerals and bauxite are concerned but it lacks coal deposits excepting lignite at Neyveli. It also does not have mica and copper deposits. Therefore, its mineral diversity is not as pronounced as that of the north-eastern peninsular belt.

4. The South-Western Belt. Western Karnataka and Goa are included in this belt. It has deposits of iron ore, garnet and clay.

5. The North-Western Belt. This belt extends along the Aravalis in Rajasthan and in adjoining parts of Gujarat. This belt has developed recently and is gradually becoming a productive region, holding great promise for the mining of non-ferrous metals (copper, lead, zinc), uranium, mica, stealite, beryllium and precious stones (aquamarine and emerald). Gujarat is fast becoming an important producer of petroleum, besides producing gypsum, manganese, salt, bauxite, etc.

Outside the main belts described above, minerals in some other parts of the country are scattered here and there. Assam has reserves of petroleum and lignite. The Himalayan region has some deposits of coal, bauxite, copper, slate, etc. Mumbai High and Godavari basin have reserves of oil and natural gas.

With the advancement of technology, even the sea bed is being exploited for minerals. There are great possibilities of obtaining large quantities of oil and natural gas, uranium, manganese, copper, zinc, lead and so many other minerals from the sea bed.

TYPES OF MINERALS

Normally two types of minerals are recognised :

(*i*) **Metallic Minerals.** These minerals contain metal. Iron ore, copper, manganese, nickel, etc. are important examples of metallic minerals.

Metallic minerals are further sub-divided into ferrous and non-ferrous minerals.

(*a*) ***Ferrous Minerals.*** These minerals have iron content. Iron-ore, manganese, chromite, pyrites, tungsten, nickel, cobalt, etc. are important examples of ferrous minerals.

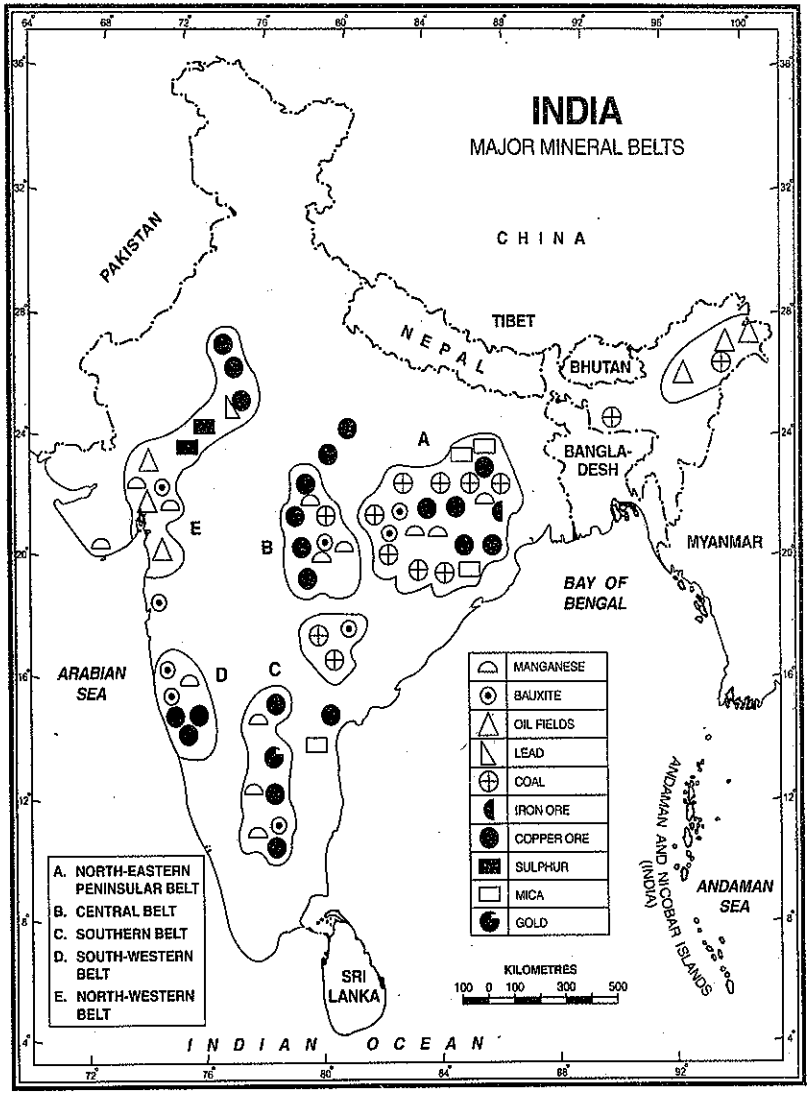

FIG. 23.1. India : Mineral Belts

(*b*) ***Non-ferrous Minerals.*** These minerals do not have iron content. Gold, silver, copper, lead, bauxite, tin, magnesium, etc. are important examples of non-ferrous minerals.

(*ii*) **Non-metallic Minerals.** These minerals do not contain metal. Limestone, nitrate, potash, dolomite, mica, gypsum, etc. are important examples of non-metallic minerals. Coal and petroleum are also non-metallic minerals. They are used as fuel and are also known as *mineral fuels*.

METALLIC MINERALS

Metallic minerals form an important section of mining activity in India and provide solid base to metallurgical industries in the country. **Fig. 23.2** shows the distribution of metallic minerals in India.

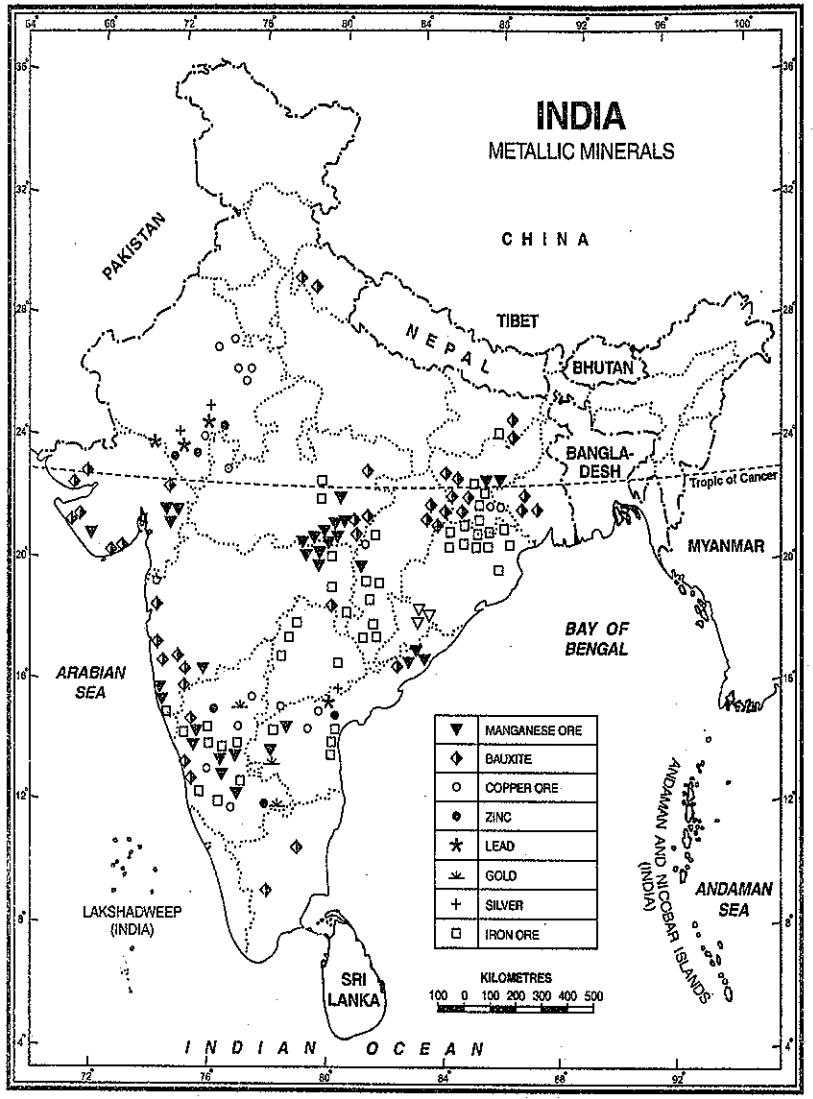

FIG. 23.2. India : Metallic Minerals

Iron Ore

Iron ore is a metal of universal use. It is the backbone of modern civilisation. It is the foundation of our basic industry and is used all over the world. The standard of living of the people of a country is judged by the consumption of iron. Iron is taken out from mines in the form of iron ore. Different types of iron ore contain varying percentage of pure iron. Following four varieties of iron ore are generally recognised.

1. Haematite. This is the best quality of iron ore with about 70 per cent metallic content and occurs as massive, hard compact and bumpy ore having reddish or coral red colour. Most of the haematite ores are found in Dharwad and Cuddapah rock systems of the peninsular India. Over 80 per cent of the haematite

ores are concentrated in eastern parts of India comprising of important iron ore producing states of Odisha, Jharkhand, Chhattisgarh and Andhra Pradesh. In the western section, the major concentration is in Karnataka, Maharashtra and Goa.

2. Magnetite. Also known as ***'black ore'***, due to blackish colour, this is the second best ore, next only to haematite with metallic content varying from 60 to 70 per cent. Like haematite, magnetite ores occur in the Darward and Cuddapah systems of the peninsular India. Magnetite ores have magnetic quality as a result of which they are known as ***magnetite ores***. Most of the reserves are found in Karnataka, Andhra Pradesh, Rajasthan, Tamil Nadu and Kerala.

3. Limonite. Limonite are inferior ores, yellowish in colour, which contain 40 to 60 per cent iron metal. These are found in Damuda series in Raniganj coal field, Garhwal in Uttarakhand, Mirzapur in Uttar Pradesh and Kangra valley of Himachal Pradesh. Though poor in quality, these have the advantage of easy and cheap mining.

4. Siderite. Also known as '*iron carbonate*' this type of iron ore is of inferior quality and contains less than 40 per cent iron. It also contains many impurities and its mining is not economically variable. However, it is self fluxing due to presence of lime.

Reserves. Hematite and magnetite are the two most important iron ores in India. According to United National Framework Classification (2010), the total reserves of haematite ore are estimated at 17,882 million tonnes. About 92 per cent of magnetic ore deposits occur in the eastern sector. Major sources of haematite ore located in Odisha, 5,930 million tonnes (33%), Jharkhand 4,597 million tonnes (26%) and Chhattisgarh 3,292 million tonnes (18%). The balance resources are spread in Andhra Pradesh, Assam, Bihar, Maharashtra, Madhya Pradesh, Rajasthan and Uttar Pradesh.

The total reserves of magnetite ore are estimated at 10, 644 million tonnes. About 97 per cent of magnetite ore resources are located in just four states namely, Karnataka 7,802 million tonnes (73%), Andhra Pradesh 1,464 million tonnes (14%), Rajasthan 527 million tonnes (5%) and Tamil Nadu (4.9%). The remaining about 3.1 per cent are found in Assam, Bihar, Goa, Jharkhand, Kerala, Maharashtra, Meghalaya and Nagaland.

Production and Distribution. Table 23.1 shows that India has progressed a lot with respect to production of iron ore and the production has consistently increased over the years. However, declining trends in production have be observed after 2009-10 which is not a good sign keeping in view the growth requirements of India.

It is worth mentioning that significant changes have taken place in the distribution pattern itself during the last few years. Goa occupied the first position among the major iron ore producing states for over a decade, but has been overtaken by Karnataka, Odisha and Chhattisgarh in due course of time. At present, over 96 per cent of India's iron ore is produced by just five states of Odisha. This fact speaks volumes of high concentration of iron ore reserves and their lopsided distribution in the country.

1. Odisha. Odisha produces over 40 per cent iron ore of India. The most important deposits occur in Sundargarh, Mayurbhanj, Cuttack, Sambalpur, Keonjhar and Koraput districts. India's richest haematite deposits are located in Barabil-Koira valley where 100 deposits are spread over 53 sq km. The ores are rich in haematites with 60 per cent iron content. Sizeable deposits occur near Gorumahisani, Sulaipat and Badampahar in Mayurbhanj district; Banspani, Tahkurani, Toda, Kodekola, Kurband, Phillora and Kiriburu in Keonjhar district; near Malangtoli, Kandadhar Pahar, Koira and Barsua in Sundargarh district, Tomka range between Patwali and Kassa in Sukind area of Cuttack district, Daitari hill along the boundary between Keonjhar and Cuttack districts, Hirapur hills in Koraput district and Nalibassa hill in Sambalpur district.

TABLE 23.1. Production of iron ore in India (Million tonnes)

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12[P]
Production	3.90	10.9	32.5	42.2	53.7	80.6	154.4	187.7	213.2	213.0	218.6	208.0	167.3

P = Provisional
Source : Economic Survey 2012-13, p. A-31.

TABLE 23.2. Production of Iron Ore in India (2011-12)

State	Production (thousand tonnes)	Percentage of all India
1. Odisha	67,013	40.06
2. Goa	33,372	19.95
3. Chhattisgarh	30,455	18.21
4. Jharkhand	18,942	11.32
5. Karnataka	13,189	7.88
6. Andhra Pradesh	1,714	1.02
7. Maharashtra	1,470	0.88
8. Madhya Pradesh	1,102	0.66
9. Rajasthan	32	0.02
Total	**1,67,289**	**100.00**

Source : Data computed from Mineral Wealth of India, 2013.

2. Goa. Production of iron ore in Goa started quite late and it is a recent development. Starting from a non-entity, Goa is now the second largest producer of iron ore in India. Though its reserves, amounting to only 11 per cent of India, are not very impressive as compared to other major producing states, it occupied the first position among the iron ore producers for several years and yielded this place to M.P. in 1990s. At present, Odisha produces more iron ore, relegating Goa to second place. Goa now produces about 20 per cent of the total production of India. In 1975, the Geological Survey of India located 34 iron bearing reserves which estimated the total ore deposits of 390 million tonnes. There are nearly 315 mines in North Goa, Central Goa and South Goa. Important deposits occur in Pirna-Adolpale-Asnora, Sirigao-Bicholim-Daldal, Sanquelim-Onda, Kudnem-Pisurlem and Kudnem-Surla areas in North Goa; Tolsia-Dongarvado-Sanvordem and Quirapale-Santone-Costi in Central Goa; and Borgadongar, Netarlim, Rivona-Solomba and Barazan in South Goa. The richest ore deposits are located in North Goa. These areas have the advantage of river transport or ropeways for local transport and that of Marmagao port for exporting the ore. Most of Goa's iron ore is exported to Japan. Most of the ore is of low grade limomite and siderite. Most of the mines are open-cast and mechanised which result in efficient exploitation of iron ore in spite of its inferior quality. About 34,000 people earn their livelihood from iron ore mining and allied activities in Goa.

3. Chhattisgarh. Chhattisgarh, has about 18 per cent of the total iron ore reserves of India. This state produced about 18 per cent of the total iron ore production of the country in 2011-12. The iron ores are widely distributed, the prominent deposits being those of Bastar and Durg districts. The reserves in these districts are estimated to be of the order of 4,064 million tonnes. These reserves are of high grade ore, containing over 65 per cent iron. Bailadila in Dakshin Bastar, Dantewada and Bijapur district, and Dalli Rajhara in Durg district are important producers. In Bailadila, 14 deposits are located in 48 km long range running in north-south direction. With estimated reserves of about 1,422 million tonnes, the Bailadila mine is the largest mechanised mine in Asia. An additional ore benefication plant with a capacity of 7.8 million tonnes has been set up in Bailadila. A 270 km long slurry pipeline carries the ore from the Bailadila pithead to the Vizag plant. This has reduced the pressure on road route to a great extent. Bailadila produces high grade ore which is exported through Vishakhapatnam to Japan and other countries where it is in great demand. The Dalli-Rajhara range is 32 km long with iron ore reserves of about 120 million tonnes. The ferrous content in this ore is estimated to be 68-69 per cent. The deposits of this range are being worked by the Hindustan Steels Plant at Bhilai. Raigarh, Bilaspur, and Surguja are other iron ore producing districts.

4. Jharkhand. Jharkhand accounts for 25 per cent of reserves and over 11 per cent of the total iron ore production of the country. Iron ore mining first of all started in the Singhbhum district in 1904 (then a part of Bihar). Iron ore of Singhbhum district is of highest quality and will last for hundreds of years. The main iron bearing belt forms a range about 50 km long extending from near Gua to near Pantha in Bonai (Odisha). The other deposits in Singhbhum include those of Budhu Buru, Kotamati Buru and Rajori Buru. The well known Noamandi mines are situated at Kotamati Buru. Magnetite ores occur near Daltenganj in Palamu district. Less important magnetite deposits have been found in Santhal Parganas, Hazaribagh, Dhanbad and Ranchi districts.

5. Karnataka. Karnataka is the fifth largest producer and accounts for nearly 8 per cent of the

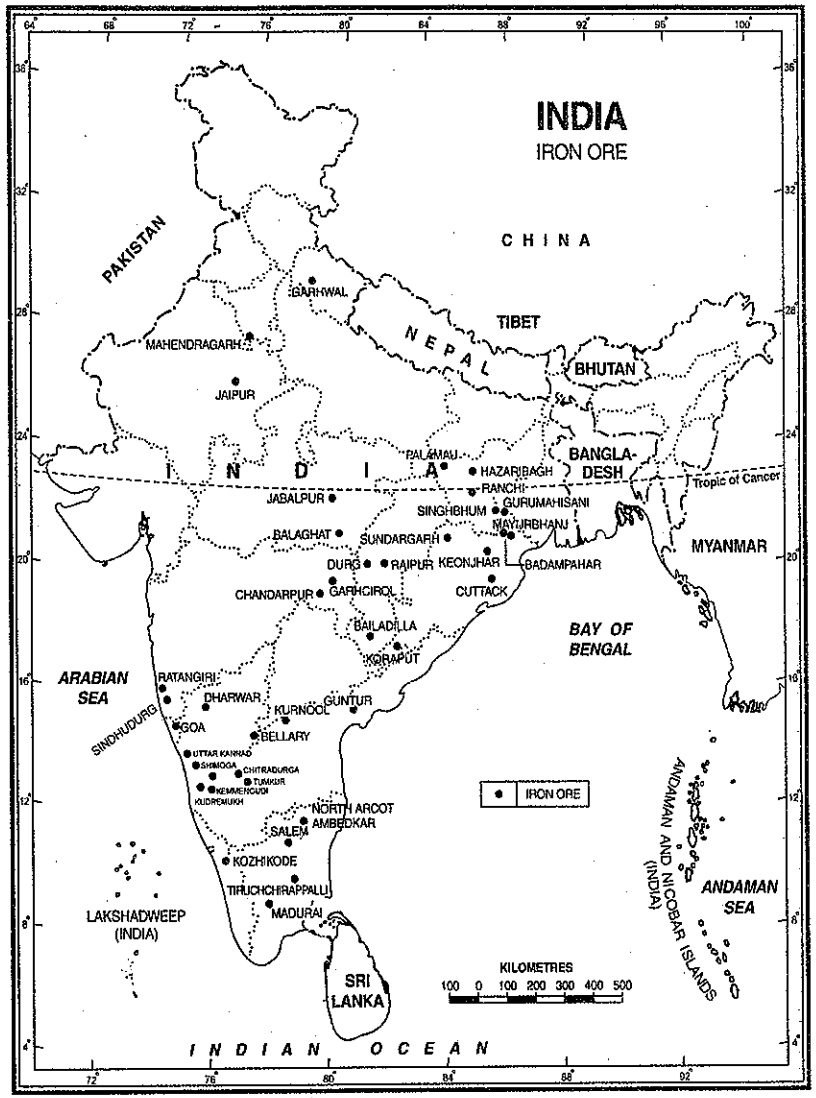

FIG. 23.3. India : Iron Ore.

total iron ore produced in India. In Karnataka production of iron ore has increased by about three times since 1980. Iron ores are widely distributed in the state, but high grade ore deposits are those of Kemmangundi in Bababudan hills of Chikmagalur district and Sandur and Hospet in Bellary district. Most of the ores are high grade haematite and magnetite. The other important producing districts are Chitradurga, Uttar Kannad, Shimoga, Dharwar and Tumkur.

Others. Apart from the major producing states described above, iron ore in small quantities is produced in some other states also. They include ***Andhra Pradesh*** (1.02%) : Kurnool, Guntur, Cuddapah, Ananthapur, Nellore; ***Maharashtra*** (0.88%) : Chandrapur, Ratnagiri and Sindhudurg;

TABLE 23.3. Exports of Iron Ore from India

Year	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity (Million tonnes)	3.2	21.2	22.4	32.5	20.2	46.9	47.2	18.1	16.5
Value (₹ crore)	17	117	303	1,049	1,634	21,416	22,184	8,985	9,562

Source : The Economic Survey 2013-14, Statistical Appendix pp. 75-77.

Madhya Pradesh (0.66%); ***Tamilnadu*** : Salem, Tiruchirapalli, Coimbatore, Madurai, Nellai Kattabomman (Tirunelveli); ***Rajasthan*** : Jaipur, Udaipur, Alwar, Sikar, Bundi, Bhilwara; ***Uttar Pradesh*** : Mirzapur, ***Uttaranchal*** : Garhwal, Almora, Nainital; ***Himachal Pradesh*** : Kangra and Mandi; ***Haryana*** : Mahendragarh; ***West Bengal*** : Burdwan, Birbhum, Darjeeling; ***Jammu and Kashmir*** : Udhampur and Jammu; ***Gujarat*** : Bhavnagar, Junagadh, Vadodara; and ***Kerala*** : Kozhikode.

Exports

India is the fifth largest exporter of iron ore in the world. We export about 25 per cent of our total iron ore production to countries like Japan, Korea, European countries and lately to Gulf countries. Japan is the biggest buyer of Indian iron ore accounting for about three-fourths of our total exports. Major ports handling iron ore export are Vishakhapatnam, Paradip, Marmagao and Mangalore.

Increasing demand for iron ore in the domestic market due to expansion of iron and steel industry in India has adversely affected our export performance as is clear from **Table 23.3**. The exports have declined from 47.2 million tonnes in 2011-12 to 16.5 million tonnes in 2013-14.

Efforts are being made to increase the production so that sufficient quantity of iron ore is available for export after meeting the requirements of the expanding home market. Export of iron ore is necessary for earning the much needed foreign exchange.

Manganese

It is an important mineral which is used for making iron and steel and it acts as a basic raw material for manufacturing its alloy. Nearly 6 kilograms of manganese is required for manufacturing one tonne of steel. It is also used for the manufacture of bleaching powder, insecticides, paints, and batteries.

Production and Distribution

India has the second largest manganese ore reserves in the world after Zimbabwe. The total reserves of manganese ore are 430 million tonnes (2010). Odisha (44%), Karnataka (22%), Madhya Pradesh (13%), Maharashtra (8%), Andhra Pradesh (4%) and Jharkhand and Goa (3% each). Rajasthan, Gujarat and West Bengal together share the remaining 3 per cent resources.

TABLE 23.4. Production of Manganese Ore in India

Year	1980-81	2008-09	2009-10	2010-11	2011-12
Production (Thousand tonnes)	1,632	2,789	2,492	2,881	2,349

Source : Statistical Outline of India (Tata) 2012-13, p. 67.

India is the world's fifth largest producer of manganese ore after Brazil, Gabon, South Africa and Australia. Production of manganese ore in India remains more or less static with slight variations from year to year It was 1,632 lakh tonnes in 1994-95 and stood at 2,349 lakh tonnes in 2011-12.

TABLE 23.5. Distribution of Manganese in India 2011-12

State	Production in tonnes	Percentage of all India Production
1. Maharashtra	6,49,898	27.66
2. Madhya Pradesh	6,48,283	27.59
3. Odisha	5,65,662	24.08
4. Andhra Pradesh	3,22,087	13.71
5. Karnataka	1,36,072	5.79
6. Jharkhand	18,265	0.78
7. Rajasthan	7,483	0.32
8. Others	1,550	0.07
Total	**23,49,300**	**100.00**

Source : Data computed from Mineral Wealth of India, 2013.

Maharashtra, Madhya Pradesh, Odisha, Andhra Pradesh and Karnataka are the major manganese producing states which account for more than 98 per cent of the total production of India. Maharashtra and Madhya Pradesh together produce more than half of India's manganese (**Table 23.5**).

1. Maharashtra. It produces about 27.66 per cent of India's manganese ore. The main belt is in Nagpur and Bhandara districts. High grade ore is found in Ratnagiri district also.

2. Madhya Pradesh. Maharashtra is closely followed by Madhya Pradesh. About 27.59 per cent of India's manganese ore is obtained from Madhya Pradesh. The state produced only 11 per cent of

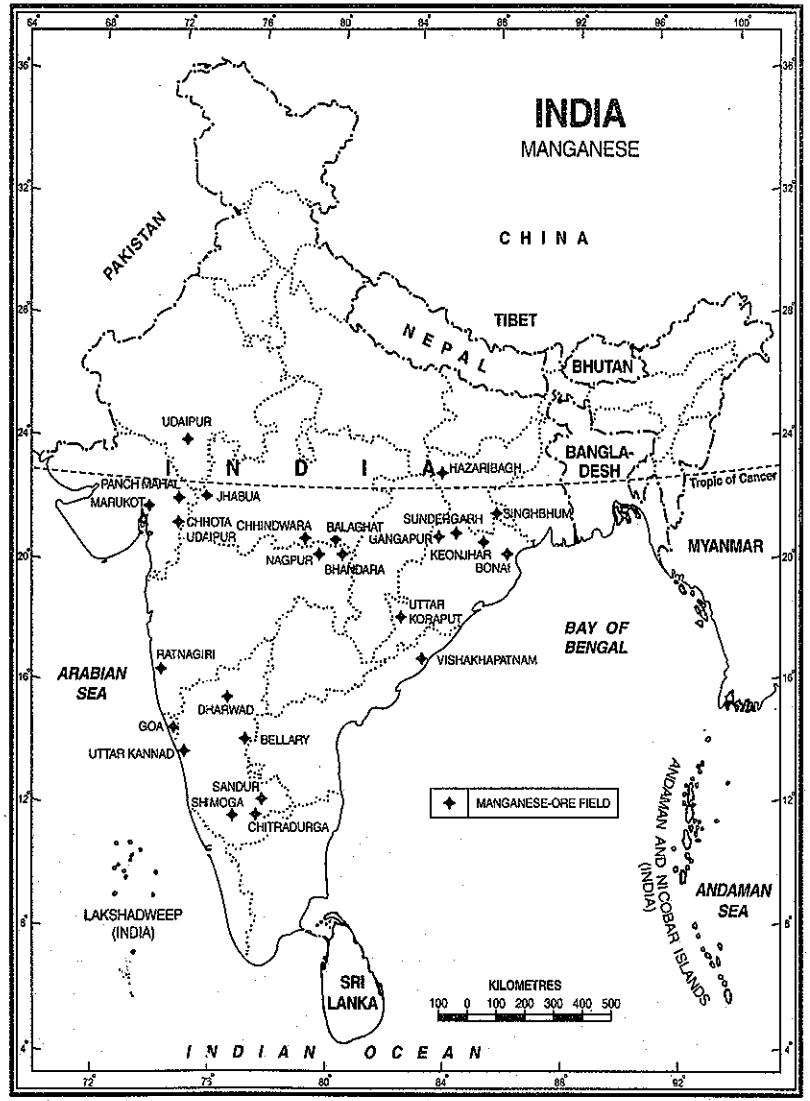

FIG. 23.4. India : Manganese

India's manganese ore just two decades ago. The main belt extends in Balaghat and Chhindwara districts. It is just an extension of the Nagpur-Bhandara belt of Maharashtra.

3. Odisha. Odisha is the third largest producer and produces over 24 per cent manganese ore of India. It is obtained from Gondite deposits in Sundargarh district and Kodurite and Khondolite deposits in Kalahandi and Koraput Districts. Manganese is also mined from the lateritic deposits in Bolangir and Sambalpur districts.

4. Andhra Pradesh. Andhra Pradesh produced more than 13% of India's manganese in 2011-12. The main belt is found between Srikakulam and Vishakhapatnam districts. Srikakulam district has the distinction of being the earliest producer (1892) of manganese ore in India. Cuddapah, Vijayanagaram and Guntur are other producing districts.

5. Karnataka. About 6 per cent of India's manganese ore is produced by Karnataka. The main deposits occur in Uttara Kannada, Shimoga, Bellary, Chitradurg and Tumkur districts.

Other producers. Jharkhand, Rajasthan, Goa, Panchmahals and Vadodara in *Gujarat*, Udaipur and Banswara in *Rajasthan* and Singhbhum and Dhanbad districts in *Jharkhand* are other producers of manganese.

Exports. Over four-fifths of the total production is consumed within the country and less than one-fifth is exported. Exports of manganese had been constantly decreasing because of rapidly increasing demand in domestic market. This is due to expansion of some of those industries, which use manganese as one of the basic raw materials. Such industries include iron and steel industry, manufacturing of dry batteries, chemicals used in photography and some other industries. So far so India had to impose ban on the export of high and medium grade ores with 35 per cent manganese content in 1971 to feed our industries. India is now exporting low grade ores with less than 35 per cent manganese content for which there is not much demand in the international market. It is worth mentioning here that the share of manganese ore exported to total production of the ore had fallen from 88.86 per cent in 1970-71 to less than 15 per cent in 2013-14. Japan is the largest buyer of Indian manganese accounting for about two-thirds of our total exports. The other buyers are the USA, UK, Germany, France, Norway, Sweden, Belgium, Czech Republic, Slovakia, Ukraine, etc.

Chromite

Chromite is an oxide of iron and chromium. It is widely used in metallurgical, refractories and chemical industries. As per United National Framework Classification (UNFC) system (2010), the total reserves of chromite is estimated at 203 million tonnes. Over 93 per cent of the resources are in Odisha, mostly in the Sukinda valley in Cuttack and Jajapur districts. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu and Andhra Pradesh. The production of chromite has recorded about three times increase during the last two decades.

Odisha is almost the sole producer, producing over 99 per cent of the total chromite production of India. Over 85 per cent of the total production of Odisha consists of high grade ore which is mainly found in Keonjhar, Cuttack and Dhenkanal districts. ***Karnataka*** is the second largest producer but lags far behind Odisha contributing less than one per cent of the total chromite of India. The main production comes from Mysore and Hassan districts. Krishna district of *Andhra Pradesh* and Tamenglong and Ukhrul districts of *Manipur* are other producers.

Copper

As a metal, copper came in use of man much earlier than iron. Copper has been used for making utensils and coins since long. Being a good conductor of electricity and ductile, it is extensively used in a vast variety of electrical machinery, wires and cables. It is also an important metal used by automobile and defence industries. Further, it is alloyed with iron and nickel to make stainless steel, with nickel to make 'morel metal' and with aluminium to make 'duralumin'. When alloyed with zinc it is known as 'brass' and with tin as 'bronze'.

Copper ore is found in ancient as well as in younger rock formations and occurs as veins, as dissemination and as bedded deposits. Mining for copper is a costly and a tedious affair because most of the copper ores contain a small percentage of the metal. Against the international average of metal content (in the ore) of 2.5 per cent, Indian ore grade averages less than one per cent.

Production and Distribution

The total reserves of copper in the country are estimated at 1558.46 million tonnes with about 12.29 million tonnes of copper metal (2010). Rajasthan has 777.17 million tonnes ore (50%) containing 4.39 million tonnes of copper. This is followed by Madhya Pradesh 377.19 million tonnes (24%) containing 3.82 million tonnes of copper and Jharkhand 288.13 million tonnes ore (19%) containing 3.09 million tonnes of copper. The rest 7 per cent of reserves are accounted for by Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Uttarakhand and West Bengal.

TABLE 23.6. Production of Copper concentrates in India

Year	Production (Thousand tonnes)
2008-09	138
2009-10	125
2010-11	137
2011-12	133

Source : Statistical Outline of India (Tata) 2012-13, p. 67.

The entire copper of India is produced by three states namely Madhya Pradesh, Rajasthan and Jharkhand.

1. Madhya Pradesh. Madhya Pradesh has become the largest producer of copper in India surpassing Karnataka, Rajasthan and Jharkhand in succession. In the year 2011-12 the state produced 59.85 per cent of the total copper production of the country. The state is blessed with a fairly large belt in Taregaon area, in Malanjkhand belt of Balaghat district. This district has recoverable reserve of 84.83 million tonnes of copper ore having 1,006 thousand tonnes of metal. Reserves of moderate size are also found in Kherlibazar-Bargaon area of Betul district. Some other areas are also reported to have copper ore reserves.

2. Rajasthan. Rajasthan has also progressed a lot with respect to production of copper and is now the second largest producing state in India accounting for over 28 per cent of the total production of the country. Most of the copper reserves are found along the Aravali range, spread over the districts of Ajmer, Alwar, Bhilwara, Chittaurgarh, Dungarpur, Jaipur, Jhunjhunu, Pali, Sikar, Sirohi and Udaipur. The Khetri-Singhana belt in Jhunjhunu district is the most important copper producing area. This belt runs in north-east to south-west direction over a distance of 80 km from Singhana to Raghunathgarh with average width varying from 3 to 5 km. The annual output of copper ore at Khetri is 1.8 million tonnes yielding around 16,000 tonnes of metal. The Kho-Dariba area about 48 km to the south-west of the Alwar city and Delwara-Kirovli area about 30 km from Udaipur are other important producers. In Kishangarh area of Ajmer district, 2.5 million tonnes of copper ore, having 0.60 per cent copper, have tentatively been estimated.

3. Jharkhand. Jharkhand, used to be the largest producer of copper till early 1980s but it has lost much importance and has slipped to third position, partly due to fall in its own production and mainly due to increased production of other states. The state's share of copper ore production has fallen from 62 per cent of the nation's total production in 1977-78 to a desperate 11 per cent in 2011-12. The main copper belt extends over a distance of 130 km. Singhbhum is the most important copper producing district where Rakha, Kendadih, Surda, Dhobani, Mosabani and some other areas have proved reserves of 58.044 million tonnes from which 1,480.12 thousand tonnes of metal may be recovered. Hasatu, Baraganda, Jaradih, Parasnath, Barkanath, etc. in Hazaribagh district; Bairakhi in Santhal Parganas area and some parts of Palamu and Gaya districts are also reported to have some deposits of copper ore.

Imports. The production of copper ore in the country always falls short of our requirements and India has to import copper from other countries. The major part of supply comes from the USA, Canada, Zimbabwe, Japan and Mexico. The quantity of import varies from year to year depending upon demand and supply.

Nickel

Nickel does not occur free in nature and is found in association with copper, uranium and other metals.

It is used as an important alloying material. When alloyed with iron, rust proof stainless steel of superior quality is obtained, from which utensils are made. Because of its greater hardness and tensile strength nickel steel is used for manufacturing armoured plates, motor cars, bullet jackets and in naval construction. When alloyed with copper or silver, it is used for making coins. Nickel-aluminium alloys are used for manufacturing aeroplanes and internal combusion engines. Metallic nickel is used for making storage batteries and as a catalyst for hydrogenation or hardening of fats and oils intended for use in soap and foodstuffs and in making *vanaspati*.

Important occurrences of nickeliferous limonite are found in the Sukinda valley of Jajapur district, Odisha, where it occurs as oxide. A suitable process is being developed for its utilization. Nickel also occurs in sulphide form along with copper mineralization in east Sighbhum district, Jharkhand. In addition, it is found associated with uranium deposits at Jaduguda, Jharkhand and process is being developed for its recovery. Other important occurrences of nickel are in Karnataka, Kerala and Rajasthan. A polymetallic sea nodules are another source of nickel. The total resources of nickel ore have been estimated at 189 million tonnes in the country. About 92 per cent resources; *i.e.*, 175 million tonnes are in Odisha. The remaining 8 per cent resources are distributed in Jharkhand (9 million tonnes) and Nagaland (5 million tonnes). Nominal resources are reported from Karnataka (0.23 million tonnes).

Lead and Zinc

Lead is a widely used metal due to its malleability, softness, heaviness and bad conductivity of heat. The most important industrial use of lead is as a constituent in alloys such as type metal, bronzes and anti-friction metal. Lead oxide is used in lead sheeting, cable covers, ammunition, paints, glass making and rubber industry. It is also made into sheets, tubes and pipes which are used in buildings, especially as sanitary fittings. It is now increasingly used in automobiles, aeroplanes, and calculating machines. Lead nitrate is used in dyeing and printing.

Lead does not occur free in nature, rather it occurs as a cubic sulphide known as galena. Galena is found in veins in limestones, calcareous slates and sandstones and occasionally in metamorphic rocks or in association with volcanic rocks.

Zinc is a mixed ore containing lead and zinc and is found in veins in association with galena, chalcopyrites, iron pyrites and other sulphide ores. It is mainly used for alloying and for manufacturing galvanized sheets. It is also used for dry batteries, white pigments, electrodes, textiles, die-casting, rubber industry and for making collapsible tubes containing drugs, pastes and the like.

The total resources of lead and zinc ores are estimated at 685.59 million tonnes. Of these, 108.98 million tonnes (16 per cent) fall under 'reserves' while balance 576.61 million tonnes (84 per cent) are classified as 'remaining resources'. The total metal content in resources is 11.55 million tonnes lead and 36.66 million tonnes zinc. Besides, 118.45 thousand tonnes lead and zinc metal resources are available. In terms of reserves, 224 million tonnes of lead metal and 12.45 million tonnes of zinc metal are estimated. Rajasthan is endowed with the largest resources of lead-zinc ore amounting to 607.53 million tonnes (88.61 per cent), followed by Andhra Pradesh 22.69 million tonnes (3.31 per cent), Madhya Pradesh 14.84 per million tonnes (2.16 per cent), Bihar 11.43 million tonnes (1.67 per cent) and Maharashtra 9.27 million tonnes (1.35 per cent). Resources are also established in Gujarat, Meghalaya, Odisha, Sikkim, Tamil Nadu, Uttarakhand and West Bengal.

TABLE 23.7. Production of Lead and Zinc Concentrates in India (Thousand tonnes)

Year	1980-81	2008-09	2009-10	2010-11	2011-12
Lead concentrates	19	134	134	145	175
Zinc concentrates	50	1,224	1,280	1,420	1,482

Source : Statistical Outline of India, Tala Services, 2012-13, p. 167.

Almost the entire production comes from Rajasthan.

Tungsten

It is a valuable metal of which the chief ore is wolfram. This metal possesses some special properties as a result of which it is almost indispensable in several industries. Its most important property is that of *self-hardening* which it imparts to steel. Over 95 per cent of the worlfram is used by the steel industry. Steel containing the requisite proportion of tungsten is mainly used in manufacturing amunitions, armour plates, heavy guns, hard cutting tools, etc. Tungsten is easily alloyed with chromium, nickel, molybdenum, titanium, etc. to yield a number of hard facing, heat and corrosion resistant alloys. It is also used for various other purposes such as electric bulb filaments, paints, ceramics, textiles, etc.

The total resources of tungsten ore in the country, have been estimated at 87.4 million tonnes containing 142.094 tonnes tungsten (WO_3) content. These resources are mainly distributed in Karnataka (42 per cent), Rajasthan (27 per cent), Andhra Pradesh (17 per cent) and Maharashtra (9 per cent). Remaining 5 per cent resources are in Haryana, Tamil Nadu, Uttarakhand and West Bengal. At Degana, Rajasthan, WO_3 value in vein deposits varies from 0.25 to 0.54 per cent while in gravel deposit, it is, on an average 0.04 per cent. In West Bengal, Bankura deposit contains, on an average, 0.1 per cent WO_3. In Kuhi-Khobana-Agargaon belt, GSI has identified seven mineralised zones in Sakoli basin in Bhandara and Nagpur districts of Maharashtra. The analysis showed 0.01 to 0.19 per cent WO_3 in Kuhi block, 0.13 to 0.38 per cent WO_3 in Khobana block and 0.48 per cent WO_3 in Pardi-Dahegaon-Pipalgaon block. The deposit contains 0.17 per cent WO_3 on an average. Gold ore at Mysore mine of Bharat Gold Mines Limited (BGML) in Karnataka has been reckoned as a potential source of scheelite. The tailing dumps at Kolar Gold Fields contain about 0.035 to 0.18 per cent WO_3. The yearly production is 45 to 50 thousand kg of ore. This is not sufficient to meet our requirements and part of the domestic requirements are met by imports.

Bauxite

Bauxite is an important ore which is used for making aluminium. It is an oxide of aluminium (name derived after Le Beaux in France). 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.

Production and Distribution

Total resources of bauxite as per UNFC in the country are placed at 3,480 million tonnes in 2010. These resources include 593 million tonnes reserves and 2,887 million tonnes remaining resources. By grades, about 84 per cent resource are of metallurgical grade. The resources of refractory and chemical grades are limited and together account for about 4 per cent. Among states, Odisha alone accounts for 52 per cent of country's resources of bauxite followed by Andhra Pradesh 18 per cent, Gujarat 7 per cent, Chattisgarh and Maharashtra 5 per cent each and Madhya Pradesh and Jharkhand 4 per cent. Major bauxite resources are concentrated in the east coast in Odisha and Andhra Pradesh.

Odisha, Gujarat, Jharkhand, Maharashtra, Chhattisgarh, Tamil Nadu and Madhya Pradesh are the main bauxite producing states in India.

1. Odisha. Odisha is the largest bauxite producing state accounting for more than one-third of the total production of India. The main bauxite belt is in Kalahandi and Koraput districts and extends further into Andhra Pradesh. This 300 km long, 40 to 100 km wide and 950 to 1300 metre thick belt is the largest bauxite bearing region of the country. The main deposits occur in Kalahandi, Koraput, Sundargarh, Bolangir and Sambalpur districts. The important mining areas include Chandgiri, Baphalimoli Parbat, Kathakal, Manjimali, Pasenmali, Kunnumali, Kodingandi, Pottangi and Karalput in Kalahandi and Koraput districts. The new aluminium plant at Damanjoli provides ready market for bauxite of this area. The aluminium plant at Doragurha provides further impetus.

TABLE 23.8. Production of Bauxite in India (Thousand tonnes)

Year	Production
1980-81	1,932
2008-09	15,464
2009-10	14,124
2010-11	12,641
2011-12	13,172

Source : Statistical Outline of India 2012-13, p. 67.

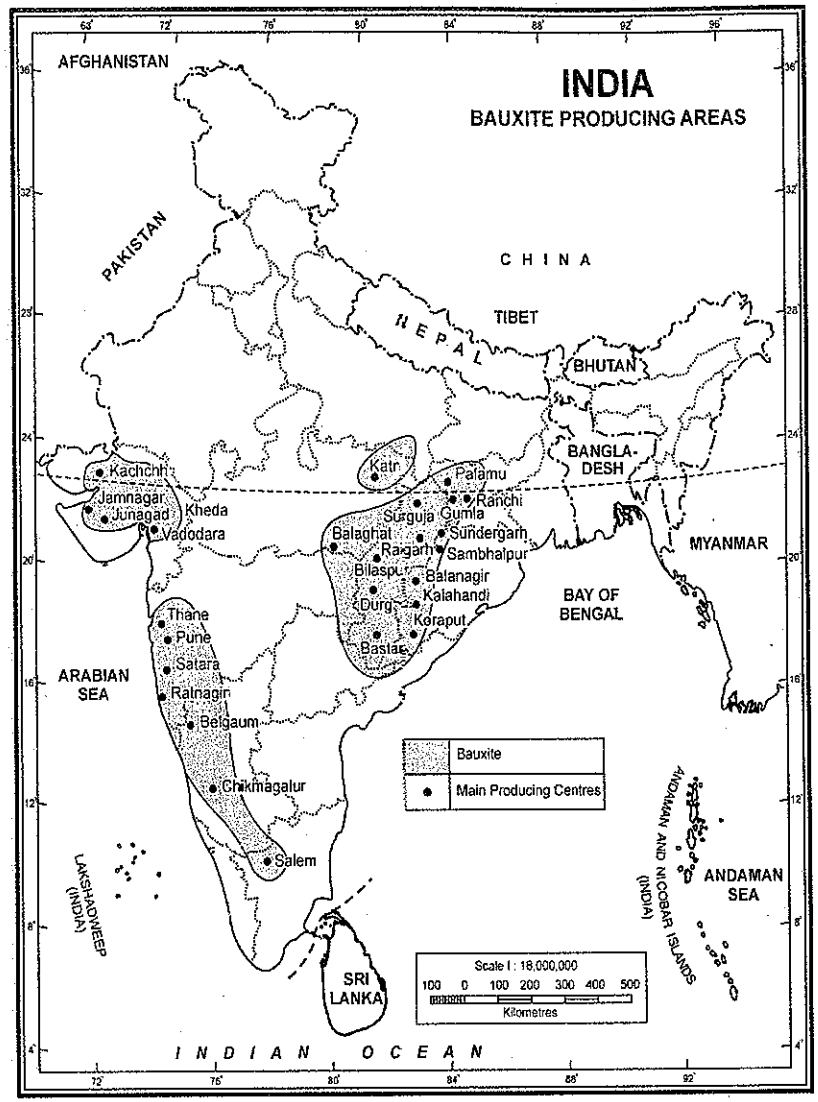

FIG. 23.5. India : Bauxite Producing Areas

2. Chhattisgarh. Chhattisgarh is the second largest producer of bauxite in India and produces more than 18 per cent bauxite of India. The Maikala range in Bilaspur, Durg districts and the Amarkantak plateau regions of Surguja, Raigarh and Bilaspur are some of the areas having rich deposits of bauxite.

3. Maharashtra. Maharashtra accounts for over 15 per cent of the total bauxite produced in India. The total recoverable reserves in the state, have been estimated to be of the order of 87.7 million tonnes. The largest deposits occur in Kolhapur district capping the plateau basalts. Udgeri, Dhangarwadi, Radhanagari and Inderganj in Kolhapur district contain rich deposits with alumina content 52 to 89 per cent. The other districts with considerable deposits are Thane, Ratnagiri, Satara and Pune.

4. Jharkhand. Jharkhand is an important bauxite producing state of India accounting for over 14 per cent of the total production. The reserves of this state are found in extensive areas of Ranchi, Lohardaga, Palamu and Gumla districts. Some bauxite is also found in Dumka and Munger districts. High grade ore occurs in Lohardaga and adjoining areas.

5. Gujarat. Gujarat produces over 6.5 per cent of the total bauxite of India, found in Jamnagar, Junagadh, Kheda, Kachchh, Sabarkantha, Amreli and Bhavnagar. The most important deposits occur in a belt which is 48 km long and 3 to 4.5 km wide lying between the Gulf of Kachchh and the Arabian sea through Bhavnagar, Junagadh and Amreli districts.

6. Madhya Pradesh. Amarkantak plateau area, the Maikala range in Shahdol, Mandla and Balaghat districts and the Kotni area of Jabalpur district are the main producers.

Goa and Karnataka also produce small quantities of bauxite.

TABLE 23.9. Distribution of bauxite in India 2011-12

State	Production in thousand tonnes	Percentage of all India production
1. Odisha	50,45,888	39.18
2. Chattisgarh	23,63,304	18.35
3. Maharashtra	19,37,898	15.05
4. Jharkhand	18,30,850	14.22
5. Gujarat	8,43,497	6.55
6. Madhya Pradesh	6,17,146	4.99
7. Goa	84,700	0.66
8. Karnataka	83,019	0.64
Others	69,092	0.56
Total	1,28,77,391	100.00

Source : Data computed from Mineral Wealth of India, 2013.

Trade. As much as 80 per cent of the bauxite is used for producing aluminium. India's exports of bauxite have been reduced considerably due to increasing demand in the home market. Still India manages to export small quantities of bauxite. The main buyers of Indian bauxite are Italy (60%), U.K. (25%), Germany (9%) and Japan (4%).

Pyrites

Pyrite is a sulphide of iron. Its economic value lies in its being the chief source of sulphur and not as an ore of iron because the high proportion of sulphur in it is injurious to iron. Sulphur is very useful for making sulphuric acid which in turn is used in several industries such as fertilizer, chemicals, rayon, petroleum, steel, etc. Elemental sulphur is useful for manufacturing explosives, matches, insecticides, fungicides and for vulcanising rubber.

Pyrite is widely distributed and occurs in many formations from the oldest crystalline rocks to the youngest sediments. The total recoverable reserves of pyrite are placed at 85.48 million tonnes of which 15.46 million tonnes are under proved category. The main deposits are found in the lower Son Valley at Amjor, Kasisiyakoh, and Kurriari in *Bihar*, in Chitradurga and Uttar Kannada districts of *Karnataka* and the pyritous coal and shale of Assam coalfields. The other deposits are in Rajasthan (Sikar), Tamil Nadu (Salem, Coimbatore, Nilgiri), Himachal Pradesh (Shimla), Meghalaya (Khasi and Jaintia Hills), Madhya Pradesh (Bilaspur, Chhindwara), Chhattisgarh (Durg and Surguja), Odisha (Mayurbhanj and Sundargarh), Uttarakhand (Garhwal, Tehri Garhwal and Almora), West Bengal (Jalpaiguri) and Arunachal Pradesh (Lower Subansiri). Production of pyrites had decreased from 1.4 lakh tonnes in 1996-97 to 9.5 thousand tonnes in 2011-12.

Gold

It is a valuable metal which occurs in auriferous lodes and some of it is found in sands of several rivers. It is used for making ornaments and is known as international currency due to its universal use.

Production and Distribution

The total resources of gold ore in the country were estimated at 493.69 million tonnes in 2010. Out of these, 24.12 million tones were placed under reserves category and the remaining 469.57 million tones under remaining resources category. Total resources of gold (primary), in terms of metal, stood at 659.84 tonnes. Out of these, 110.54 tonnes were placed under reserves category and 549.30 tonnes under remaining resources category. The resources include place-type gold ore in Kerala estimated at

26.12 million tonnes containing 5.86 tonnes gold metal. Among the states, the largest resources in terms of the metal ore (primary) are located in Bihar (45 per cent) followed by Rajasthan (23 per cent), Karnataka (22 per cent), Wet Bengal (3 per cent and Andhra Pradesh and Madhya Pradesh (2 per cent each) each. Remaining 3 per cent resources of ore are located in Chattisgarh, Jharkhand, Kerala, Maharashtra and Tamil Nadu. In terms of metal content, Karnataka has the highest followed by Rajasthan, Bihar, Andhra Pradesh, Jharkhand, etc.

There are three gold fields in the country, namely Kolar Gold Field, Kolar district, Hutti Gold Field in Raichur district (both in Karnataka) and Ramgiri Gold Field in Anantpur district (Andhra Pradesh).

Karnataka is the largest producer of gold in India. The main reserves are in Kolar, Dharwad, Hassan and Raichur districts. Some gold reserves are also reported from a number of scattered localities in Gulbarga, Belgaum, Bellary, Mysore, Mandya, Chikmagalur and Shimoga districts. This state used to produce about 88.7 per cent of India's gold.

Although every district of Karnataka has some reserves of gold, the most important reserves are found in Kolar Gold Fields, Kolar district and produces about 57.75 per cent of the total production of the state. The deposits in Kolar Gold Field occur in a 80 km long (north-south) and 3-4 km wide belt in which gold bearing quartz veins are confined to a 6-7 km section near Marikuppam. The first mining operations in the Kolar Gold Fields started in 1871 and the area still continues to be a major supplier of gold in India. About 3,539 thousand tonnes of gold ore having 17,738 kg of gold content have been proved during the recent surveys conducted by the Geological Survey of India for locating new lodes. The main gold mine at Kolar is one of the deepest mines of the world and the production from this mine is decreasing day by day due to heavy cost of extraction. Moreover, most of the gold has already been taken out and very little gold is left in the mine. Now gold is available at depth of more than 3,000 metres and it is not economically viable to extract gold at this depth.

Next to Kolar, but far below in production, are the Hutti mines in Raichur district. In the Hutti gold field the gold mining belt is 3.7 km long and 1,220 m wide with six auriferous quartz reefs. It produced 593.3 kg of gold in 1915, but the production fell and the mine had to be closed down in 1920. The main problem with the Hutti mines is the low grade of ore. The mine reopened in 1948 and has been operating irregularly since then. The *in situ* gold reserves of gold fields of Raichur district are estimated at 4.5 million tonnes with a total gold content of about 45,000 kg.

Some gold is found in the Gadag field in Dharwad district. New fields have been discovered in Ballara (Tumkur district), Kempinkole (Hassan district), Honnoli (Shimoga district), Siddarhalli (Chikmagalur district), and Munghur (Gulbarga district) areas.

Andhra Pradesh. Though lagging far behind Karnataka, Andhra Pradesh is the second largest producer of gold in India. On the basis of the detailed mapping done by the Geological Survey of India in recent years, a total of 7.06 million tonnes of ore and 37,025 kg of gold metal have been assessed in the state. The main deposits are found in Ramagiri in Anantapur district. However, this field is almost exhausted. The other areas of gold deposits are Bisanattam and Palachchur in Chittoor district and Jonnagiri in Kurnool district.

TABLE 23.10. Production of Gold in India

Year	Production in kg.
1980-81	2,412
2008-09	2,438
2009-10	2,084
2010-11	2,239
2011-12	2,817

Source : Statistical Outline of India (Tata) 2012-13, p. 67.

Alluvial Gold

Apart from the gold mines in the above mentioned areas, some gold is collected from the sands and gravels of several rivers. Gold is often liberated from the rocks by weathering and its particles get concentrated at certain places in the rivers. Such deposits are called placer deposits from which gold is recovered by *panning*. Although very small in quantity, this type of gold is widely spread in a large number of rivers.

Jharkhand. In addition to the above mentioned two states, Jharkhand is an important producer of gold in India. Jharkhand has both alluvial and native gold. Alluvial gold is obtained from the sands of the *Subarnarekha* (gold streak) river, as its name suggests, Sona nadi in Singhbhum district and the streams draining the Sonapat valley. Native gold is found near Lowa in Singhbhum district and in some other parts of Chota Nagpur plateau.

Kerala. The river terraces along the Punna Puzha and the Chabiyar Puzha have tracts of gold. Alluvial gold is found in the Ambankadava Puzha, Chabiyar Puzha and in the rivers near Mannarkkat.

Small quantities of gold are collected from rivers in Shimla and Bilaspur in Himachal Pradesh, Kargil area along the terraces of the Indus river and in alluvial and morainic deposits of Dras river in Jammu and Kashmir, Balaghat, and Seoni districts in Madhya Pradesh, Bastar, Raipur and Raigarh in Chhattisgarh and parts of Purulia district of West Bengal.

Silver

Silver is another precious metal produced in India. It is valued next only to gold for making ornaments due to its softness and attractive white colour. It had been an important currency metal in several parts of the world. It is also used in the manufacture of chemicals, electroplating, photography and for colouring glass, etc.

The chief ore minerals of silver are *agentine*, *stephanite*, *pyrargyrite* and *proustite*. It is found mixed with several other metals such as copper, lead, gold, zinc, etc.

India is not a major producer of silver in the world. The main production comes from Zawar mines in Udaipur district of Rajasthan. Here, silver is obtained as a by-product during the concentration and smelting of galena ore in Hindustan Zinc Smelter. The silver content varies from 171.4 gm to 774.5 gm per tonne of zinc and lead concentrates respectively. The Tundoo Lead Smelter in Dhanbad district of Jharkhand is another important producer of silver as a by-product of lead. Some silver is produced by Kolar Gold Fields and Hutti gold mines in Karnataka during refining of gold. The Hindustan Copper Ltd. at Maubhandar smelter in Singhbhum district of Jhakhand obtains silver from copper slimes. Silver is also produced by Vizag Zinc smelter in Andhra Pradesh from the lead concentrates.

Traces of silver occur in Hazaribag, Palamu, Ranchi and Singhbhum districts of Jharkhand; Cuddapah, Guntur and Kurnool districts of Andhra Pradesh; Vadodara in Gujarat, Bellary district of Karnataka, Baramula district of Jammu and Kashmir and Almora district of Uttarakhand.

NON-METALLIC MINERALS

India also produces a large number of non-metallic minerals although only a few of them have assumed as much industrial and economic importance as is done by the metallic minerals. However, they are used in a large variety of industries; the major industries being cement, fertilizers, electricals, etc.

Mica

Mica has been used in India since ancient times as a medicinal item in Ayurveda and is known as ***abhrak***. With the development of electrical industry, mica found new vistas of use. Its insulating properties have made it a valuable mineral in electrical and electronics industry. It can withstand high voltage and has low power loss factor. The three major types of mica found in India are : *muscovite*, *phlogopite* and *biotite*.

Reserves

Most important mica-bearing pegmentities occur in Andhra Pradesh, Bihar, Jharkhand, Maharashtra and Rajasthan. Occurrences of mica pegmatites are also reported from Gujarat, Haryana, Karnataka, Kerala, Odisha, Tamil Nadu and West Bengal. The total resources of mica in the country are estimated at 5,32,237 tonnes out of which 1,90,741 tonnesa re placed under reserves category and 3,41,496 tonnes under remaining resources category. Andhra Pradesh leads with 41 per cent share in country's total resources followed by Rajasthan (21 per cent), Odisha (20 per cent), Maharashtra (15 per cent), Bihar (2 per cent) and balance (less than 1 per cent) in Jharkhand.

Production and Distribution

India has a near monopoly in the production of mica, producing about 60 per cent of world's total production. Production was just 772 tonnes in 1947-

48 which increased to about ten thousand tonnes within three years. The production increased at a rapid pace up to 1960-61 and there was a record production of 28,347 tonnes in that year. But afterwards it showed a declining trend and the production came down to 1,807 tonnes in 2011-12.

This decrease is the result of the fall in its demand in the international market. Earlier, there was no substitute for mica. Now materials like plastics and synthetics have been developed which can be used as substitutes for mica.

About 95 per cent of India's mica is found in just three states of Andhra Pradesh, Rajasthan and Jharkhand. Some mica is produced in Bihar also.

1. Andhra Pradesh. Andhra Pradesh is the largest mica producing state of India. In 2011-12, this

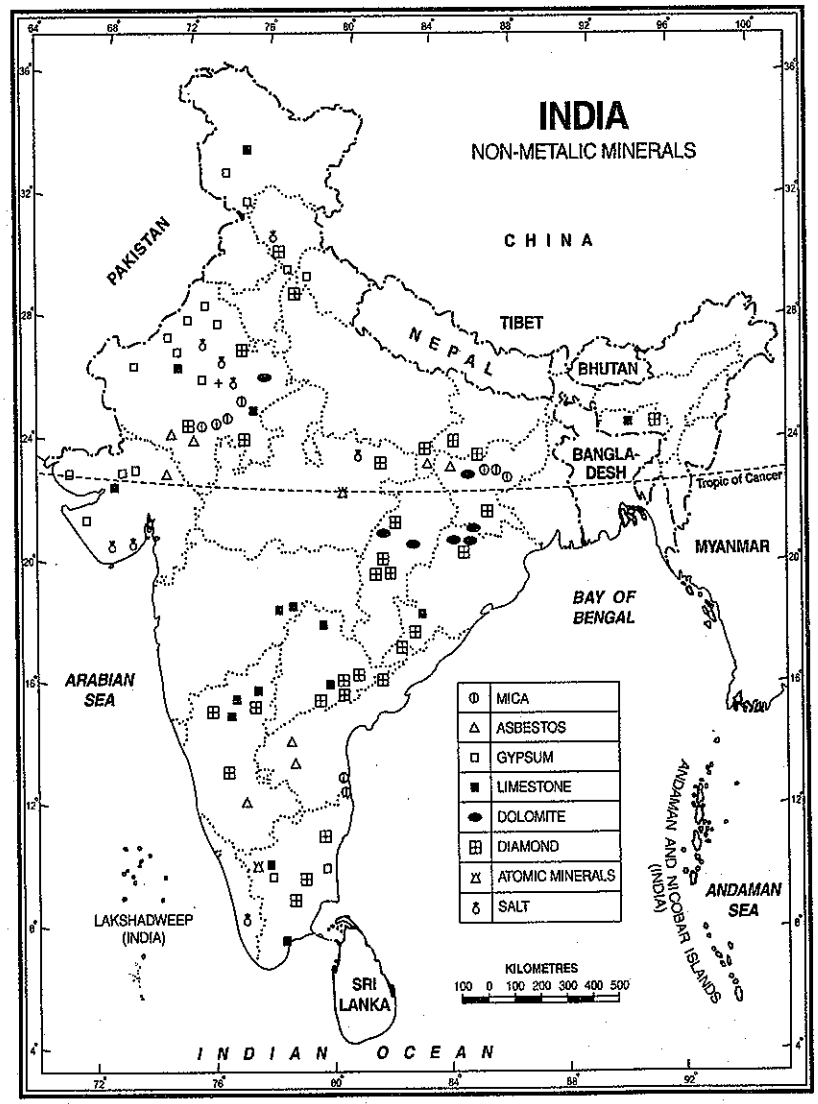

FIG. 23.6. India : Non-Metallic Minerals

state produced 1,694 tonnes of mica which was more than 93 per cent of all India production. In the recent years, share of Andhra Pradesh has progressed in respect to mica production. The mica belt lies in Nellore district and is 100 km long and 25 km wide. Nellore mica is generally light green in colour; it is generally stained and spotted. The other districts with workable mica deposits are Vishakhapatnam, West Godavari and Krishna (Tiruvur). Shah mine in Gudur taluka is the deepest with mining being done at 300 m depth.

2. Rajasthan. Although occupying the second position among the mica producing states of India, Rajasthan is not as important a producer as Andhra Pradesh is. This state produced 113 tonnes or 6.3 per cent of India in 2011-12. The main mica belt extends from Jaipur to Udaipur. This is 322 km long with an average width of 96 km. This belt broadens around Kumbhalgarh and Bhilwara. The main producing districts are Bhilwara, Jaipur, Tonk, Sikar, Dungarpur and Ajmer.

3. Jharkhand. Jharkhand is the third largest producer of mica in India. Mica in Jharkhand is found in a belt extending for about 150 km in length and 32 km in width from eastern part of Gaya district of Bihar across Hazaribagh, Girdih and Munger to Bhagalpur district. This belt contains the richest deposits of high quality ruby mica. The main centres of mica production in this belt are Kodarma, Dhorhakola, Domchanch, Dhab, Gawan, Tisri, Chakai and Chakapathal. Outside the main mica belt, mica occurs in Dhanbad, Palamu, Ranchi and Singhbum districts.

Other producers. The other areas with small deposits of mica are *Gujarat* (Banaskantha, Vadodara, Sabarkantha), *Kerala* (Alleppey and Kollam), *Tamil Nadu* (Nilgiri, Coimbatore, Salem and Tiruchirapalli), *Madhya Pradesh* (Balaghat and Chhindwara), *Chhattisgarh* (Bilaspur, Bastar and Surguja) and *Uttar Pradesh* (Mirzapur). Some deposits have also been reported from Odisha, Haryana, Himachal Pradesh and West Bengal.

Exports. India is not only the largest producer but also the largest exporter of mica in the world. In spite of the threat from synthetic mica, certain grades of Indian mica will remain vital to the world's electrical industries.

Most of the exports are routed through the ports of Kolkata and Vishakhapatnam. Japan (19%), the USA (17%), U.K. (7%), Norway (7%), Russia, Poland, Germany, Czech Republic, Slovakia, Hungary, France, the Netherlands, etc. are the main buyers purchasing about 80 per cent the total mica exported by India. However, trends in exports of mica from India are quite fluctuating (*see* **Table 23.11**).

Limestone

Limestone is associated with rocks composed of either calcium carbonate, the double carbonate of calcium and magnesium, or mixture of these two constituents. In addition to the main constituents of calcium and magnesium carbonates, 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 sequences from pre-cambrian to recent except in Gondwana.

The total resources of limestone of all categories and grades are estimated at ,84,935 million tonnes of which 14,926 million tonnes (8 per cent) are under reserves category and 170,.009 million tonnes (92 per cent) are under remaining resources category. Karnataka is the leading state having 28 per cent of the total resources followed by Andhra Pradesh (20 per cent). Rajasthan (12 per cent), Gujarat (11 per cent), Meghalaya (9 per cent) and Chhattisgarh (5 per cent).

TABLE 23.11. Export of Mica from India

Year	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity (Thousand tonnes)	28.4	26.7	16.7	42.0	63.2	125.8	131.1	126.8	126.4
Value (₹ crore)	–	16	18	35	64	189	238	276	304

Source : Economic Survey 2013-14, Statistical Appendix, pp. 75-77.

Limestone is used for a large variety of purposes. Of the total consumption, 75 per cent is used in cement industry, 16 per cent in iron and steel industry and 4 per cent in the chemical industries. Rest of the limestone is used in paper, sugar, fertilizers, glass, rubber and ferromanganese industries.

Rapid pace of industrialisation in the country has resulted in an accelerated rate of production of limestone. It has increased from a mere 30.2 million lakh tonnes in 1980-81 to over 256 million tonnes in 2011-12 (**Table 23.12**).

TABLE 23.12. Production of Limestone in India

Year	Production in million tonnes
1980-81	30.2
2008-09	222.0
2009-10	233.0
2010-11	238.0
2011-12	256.6

Source : Statistical Outline of India (Tata) 2012-13, p. 67.

Although almost all the states of India produce some quantity of limestone, over three-fourths of the total limestone of India is produced by six states of Andhra Pradesh and Telangana, Rajasthan, Madhya Pradesh, Gujarat, Tamil Nadu and Karnataka.

TABLE 23.13. Distribution of Limestone in India 2011-12

State	Production in thousand tonnes	Percentage of all India production
1. Andhra Pradesh (including Telangana)	53,882	20.99
2. Rajasthan	47,930	18.67
3. Madhya Pradesh	32,658	12.72
4. Gujarat	24,224	9.44
5. Tamil Nadu	21,736	8.47
6. Karnataka	20,228	7.88
7. Chhattisgarh	20,124	7.84
Others	35,887	13.99
Total	**2,56,669**	**100.00**

Source : Data computed from Mineral Wealth of India, 2013.

1. Andhra Pradesh. Andhra Pradesh possesses about one-third of the total reserves of the cement grade limestone in the country. This state along with Telangana produced about 21 per cent of India's limestone in 2011-12. Extensive deposits occur in Cuddapah, Kurnool, Guntur, Krishna. In **Telangana**, Nalgonda, Adilabad, Warangal, Mehbubnagar and Karimnagar are the major producing districts.

2. Rajasthan. Rajasthan has about 6 per cent of the reserves and produces over 18 per cent of the total limestone of India. Jhunjhunu, Banswara, Jodhpur, Sirohi, Bundi, Ajmer, Bikaner, Dungarpur, Kota, Tonk, Alwar, Sawai Madhopur, Chittaurgarh, Nagaur, Udaipur and Pali are the main producing districts.

3. Madhya Pradesh. Madhya Pradesh is the third largest producer of limestone and accounts for over 12 per cent of the total limestone production of India. Large deposits occur in the districts of Jabalpur, Satna, Betul, Sagar, Damoh and Rewa. The total reserves of all grades of limestone are estimated to be over 1,500 million tonnes.

4. Gujarat. Gujarat has about 13 per cent of the reserves but produces less than 10 per cent of the total limestone of India. High grade limestone deposits occur in Banaskantha district. The other important producing districts are Amreli, Kachchh, Surat, Junagadh, Kheda and Panchmahals.

5. Tamil Nadu. Large scale reserves in Ramnathapuram, Tirunelveli, Tiruchchirappalli, Salem, Coimbatore, Madurai, and Thanjavur districts enable Tamil Nadu to provide more than eight per cent limestone of the country. Most of the deposits, except those of Salem district, are of cement grade limestone.

6. Karnataka. Gulbarga, Bijapur and Shimoga districts of Karnataka possess about one-third of cement grade limestone of India. Currently, this state produces a little less than 8 per cent of the total limestone of India. The main producing districts of all grades of liemstone are Gulbarga, Chitradurg, Tumkur, Belgaum, Bijapur, Mysore and Shimoga.

7. Chhattisgarh. Chhattisgarh accounts for 7.84 per cent of total limestone of India. Deposits of limestone occur in Bastar, Bilaspur, Raigarh, Raipur and Durg districts.

Others. Apart from the above mentioned major producers, liemstone is also produced in *Sikkim*, *Maharashtra* (Yavatmal, Chandrapur, Nanded and Ahmadnagar), *Odisha* (Sundargarh, Sambalpur and Kalahandi), *Jharkhand* (Palamu, Hazaribagh, Ranchi and Singhbhum), *Himachal Pradesh* (Bilaspur, Kangra and Chamba), *Haryana* (Mahendragarh and Ambala), *Assam* (Nagaon and Sibsagar), *Meghalaya* (Garo, Khasi and Jaintia hills), *Uttar Pradesh* (Mirzapur, Lucknow and Unnao), *Uttarakhand* (Dehra Dun and Mussoorie), *West Bengal* (Darjeeling and Jalpaiguri) and *Jammu and Kashmir* (Anantnag and Jammu).

Dolomite

Limestone with more than 10 per cent of magnesium is called dolomite; when the percentage rises to 45, it is *true dolomite*. The economic uses of dolomite are chiefly metallurgical; as refractories, as blast furnace flux as a source of magnesium salts and in fertilizer and glass industries. Iron and Steel industry is the chief consumer of dolomite accounting for over 90 per cent consumption followed by fertilizer (4%), ferro-alloys and glass (2% each), alloy steel (1%) and others (1%). Dolomite is widely distributed in the all parts of the country.

Total resources of dolomite are placed at 7,730 million tonnes, out of which 738 million tonnes are placed under reserves category and the balance 6,992 million tonnes under remaining resources category. Major share of about 91 per cent resources is distributed in eight states : namely, Madhya Pradesh (29 per cent), Andhra Pradesh (15 per cent), Chattisgarh (11 per cent), Odisha and Karnataka (9 per cent each), Gujarat (7 per cent), Rajathan (6 per cent) and Maharashtra (5 per cent). The remaining (9 per cent) resources are distributed in Arunachal Pradesh, Jharkhand, Haryana, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

Chhattisgarh, Odisha, Andhra Pradesh, Karnataka, and Madhya Pradesh are the main dolomite producing states which account for more than 90 per cent of India'a total production. Chattisgarh and Odisha are the two outstanding states which produce more than half of India's dolomite (**Table 23.14**).

1. Chhattisgarh. Chhattisgarh is the largest dolomate producing state of India which contributes more than 30 per cent of the total production of the country. The recoverable reserves of all grades of dolomite are estimated to be 1,638 million tonnes.

TABLE 23.14. Distribution of Limestone in India 2011-12

State	Production in thousand tonnes	Percentage of all India production
1. Chhattisgarh	16,28,165	30.06
2. Odisha	11,74,594	21.68
3. Andhra Pradesh	9,81,800	18.13
4. Karnataka	5,48,694	10.13
5. Madhya Pradesh	3,60,907	6.66
6. Rajasthan	2,34,709	4.33
7. Jharkhand	1,90,769	3.52
8. Gujarat	1,69,235	3.12
Others	1,27,944	2.37
Total	**54,16,817**	**100.00**

Source : Data computed from Mineral Wealth of India, 2013.

The main deposits occur in Bastar, Bilaspur, Durg and Raigarh districts.

2. Odisha. Odisha is the second largest producer of dolomite and accounts for over 21 per cent of the total production of dolomite in India. The total reserves of recoverable dolomite of all grades are of the order of 562.6 million tonnes out of which 256 million tonnes are in Birmitrapur locality alone. The main deposits occur in Sundargarh, Sambalpur and Koraput districts. In Gangapur area, they occur near Sukra and extend for a total length of about 100 km.

3. Andhra Pradesh. This is the third largest dolomite producing state of India contributing more than 18 per cent of the total production. Anantapur, and Kurnool are the main producing districts. In the neighbouring **Telangana** state, Khammam is the leading dolomite producing district.

4. Karnataka. Karnataka produces slightly more than ten per cent dolomite of India. Belgaum, Bijapur, Chitradurga, Mysore, Uttar Kannada and Tumkur contribute major part of the state's production.

5. Madhya Pradesh. This state has vast reserves of dolomite and accounts for more than 6 per cent of India's production. Most of the deposits occur along the Vindhya Range.

6. Rajasthan. Rajasthan produces over 4 per cent of India's dolomite. Ajmer, Alwar, Bhilwara,

Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagaur, Pali, Sawai Madhopur, Sikar and Udaipur are the main producing districts.

7. Jharkhand. Dolomite occurs in bands to the north of Chaibasa in Singhbhum district. Some dolomite also occurs in Palamu district.

Others. Among the other producers are Gujarat (Junagad, Kheda, Jamnagar and Amreli), West Bengal (Jalpaiguri), Uttar Pradesh (Banda and Mirzapur), Uttarakhand (Dehra Dun, Nainital and Tehri Garhwal), Arunachal Pradesh (Kamang), Haryana (Mahendragarh), Himachal Pradesh (Shimla, Solan and Mandi), Maharashtra (Nagpur, Chandrapur and Yavatmal) and Tamil Nadu (Salem and Triunelveli).

Asbestos

Two quite different minerals are included under this name; one, a variety of amphibole, resembling tremolite and the other, more important, a fibrous variety of serpentine (chrysotile). Chrysotile is more important variety and accounts for 80 per cent of the asbestos of commercial use.

Asbestos has found great commercial value due to its fibrous structure, its capability to be readily separated into filaments of high tensile strength and its great resistance to fire. It is widely used for making fire-proof cloth, rope, paper, millboard, sheeting, belt, paint, etc. and for manufacturing fire proof safes, insulators, felts, etc. It is also used in making aprons, gloves, curtains, brake-linings in automobiles and insulating mats. Asbestos cement products like sheets, slates, pipes and tiles are used for building purposes. When asbestos is brittle, it is made into filter pads for filtering acids, organic liquids and other chemicals. Mixed with magnesia, it is used for making 'magnesia bricks' used for heat insulation.

Reserves of all categories and varieties of asbestos are placed at about 1.046 million tonnes. The production was at low key till 1971 but picked up after that. From a record production of 42,699 tonnes in 1993-94, it fell drastically to 27,180 tonnes in 1996-97 and further to 280 tonnes in 2011-12.

Two states of Rajasthan and Andhra Pradesh produce almost the whole of asbestos of India. *Rajasthan* is the largest producer. This state produced 13,539 tonnes of asbestos in 2012-13 which was over 94 per cent of the total production of India. Important occurrences are known in Udaipur, Dungarpur, Alwar, Ajmer and Pali districts. In **Andhra Pradesh,** asbestos of fine quality occurs in Pulivendla *taluk* of Cuddapah district. There are several occurrences between Chitravati and Papaghani rivers. The 15 km long zone between Lopatanuthula and Brahamnapalle is most promising. In **Karnataka,** the main deposits occur in Hassan, Mandya, Shimoga, Mysore and Chikmaglur districts.

In addition to the above mentioned major producers, some asbestos is produced in Jharkhand, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Gujarat, Uttarakhand and Nagaland also.

Magnesite

It is an alteration product of dunites (peridotite) and other basic magnesian rocks. It is primarily used for manufacturing refractory bricks. It is also used as a bond in abrasives and in the manufacture of special type of cement for artificial stone, tiles, fire-proof floorings and for extraction of the metal magnesium. Steel industry also uses magnesite.

The total reserves/resources of magnesite are about 335 million tonnes of which reserves and remaining resources are 42 million tonnes and 293 million tonnes, respectively. Substantial quantities of resources are established in Uttarakhand (69 per cent), followed by Rajasthan (16 per cent) and Tamil Nadu (12 per cent). Resources are also located in Andhra Pradesh, Himachal Pradesh, Jammu and Kashmir, Karnataka and Kerala. Occurrences of magnesite in Tamil Nadu are low in lime and high in silica whereas those of Uttarakhand are high in lime and low in silica.

Production of magnesite recorded more than four-fold increase in forty years from 1.19 lakh tonnes in 1951 to 5.28 lakh tonnes in 1990-91 after which production regularly declined and stood at 2.17 lakh tonnes in 2011-12.

Tamil Nadu, Uttarakhand, Karnataka and Rajasthan produce almost the entire magnesite of India.

Tamil Nadu is the largest producer of magnesite in India. In 2011-12, this state produced more than two-thirds magnesite of India. Tamil Nadu has one of the largest deposits of magnesite in the world and the largest in India are found at Chalk Hills near Salem town. Some other deposits occur in Coimbatore, Dharmapuri, Nilgiri, Periyar and Tirunelveli. In **Uttarakhand,** Almora district with estimated reserves of 250 lakh tonnes has a 3.2 km long and 6 to 9 metre thick belt between Agar and Chahana. Chamoli district is also reported to have some deposits of magnesite. In **Karnataka,** magnesite veins are found in Hassan, Mysore and Kodagu districts. Ajmer, Udaipur and Pali districts in **Rajasthan,** Chamba in **Himachal Pradesh** and Udhampur in **Jammu and Kashmir** also produce some magnesite.

TABLE 23.15. Distribution of Magnisite in India 2011-12

State	Production in tonnes	Percentage of all India production
1. Tamil Nadu	1,47,207	67.63
2. Uttarakhand	62,124	28.54
3. Karnataka	8,331	3.83
Total	2,17,662	100.00

Source : Data Computed from Mineral Wealth of India 2013.

Kyanite

Kyanite occurs in metamorphic aluminous rocks and is primarily used in metallurgical, ceramic, refractory, electrical, glass, cement and a number of other industries due to its ability to stand high temperatures. It is also used in making sparking plugs in automobiles.

India has the largest deposits of kyanite in the world. All the three grades of kyanite are found here. The first grade has an aluminium content from 62 to 64 per cent, the second grade from 58 to 62 per cent and the third grade from 54 to 58 per cent.

The total resources of kyanite are placed at 103.24 million tonnes. Out of these resources, only 1.57 million tonnes are the reserve and 101.67 million tonnes are the remaining resources. Out of total resources, high and medium-grade resources together are merely 1.5 per cent, low grade 7.6 per cent, mixed grade 0.8 per cent, quartz kyanite gneiss and kyanite schist rock 88.6 per cent and granular, others and not-known grades 1.6 per cent. Statewise, the share of Andhra Pradesh alone is more than 78 per cent of the resources followed by Karnataka 13 per cent and Jharkhand 6 per cent. Remaining 3 per cent resources are in Kerala, Maharashtra, Rajasthan, Tamil Nadu and West Bengal.

The production of kyanite has been fluctuating since 1951 but there has been falling trend since 1990-91. The total production of Kyanite in 2011-12 was 4,064 tonnes. Jharkhand, Maharashtra and Karnataka produce practically the whole of kyanite of India.

1. Jharkhand is the largest producer of kyanite. This state produced 4,011 tonnes of kyanite in 2011-12 which was about 98 per cent of the total kyanite produced in India. Ores with high degree of purity with percentages of aluminium silicate reaching 95 to 97 are found in the Singhbhum district. Here kyanite occurs mainly as kyanite quartz rock and as massive kyanite-rock in beds of considerable size in the Archaean schists. This rock forms a bed nearly 130 km in length stretching from Lapsa Buru to Kharsawan in Saraikela. This has been the largest in the world and also the best in quality but now it is nearly exahusted. The other deposits in this district occur near Ghagidih, Badia, Bakra, Mohanpur, Jagnathpur, Bhakar, Hatiland, Singpura, Daontauri, Padampur and Shirbai. Small deposits are reported from Dhanbad and Ranchi districts also.

2. Maharashtra. Maharashtra produced only 45 tonnes or 1.4 per cent of the total kyanite produced in India in 2011-12 and occupied a distant second position among the major producing states of the country. Most of the reserves are in the districts of Bhandara and Nagpur where the total reserves of all grades are estimated at 70,652 tonnes.

Others. Some deposits of kyanite are also reported from **Odisha** (Dhenkanal, Sundargarh and Mayurbhanj), **Rajasthan** (Udaipur, Bhilwara and Dungarpur), **Tamil Nadu** (Kanniyakumari, Tiruchirapalli) and **Andhra Pradesh** (Nellore). Telangana (Khammam), Karnataka (Chickmaglur, Chitradurga, Mandya, Mysore, Dakshin Kannada and Shimoga)

Sillimanite

The occurrence and uses of sillimanite are almost the same as those of kyanite. The total resources of sillimanite are placed at 66.98 million tonnes. Out of

these resources, the reserves are only 4.08 million tonnes, while about 62.90 million tonnes are the remaining resources. Out of total resources, more than 72.1 per cent are granular high-grade, while quartz sillimanite rocks and sillimanite bearing rocks are about 22.7 per cent Resources of massive sillimanite of all grades are about 5.0 per cent. The resources are located mainly in Tamil Nadu (27 per cent), Odisha (20 per cent), Uttar Pradesh (17 per cent), Andhra Pradesh (14 per cent), Kerala (11 per cent) and Assam (7 per cent). Remaining 4 per cent resources are in Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Rajasthan and West Bengal.

Odisha, Kerala, Maharashtra and Rajasthan produce practically the whole of sillimanite of the country.

Odisha is the largest producer of sillimanite in India. This state produces as much as 56 per cent sillimanite of India. About 16.48 million tonnes of sillimanite reserves have been reported mainly from Ganjam district. **Kerala** is the second largest producing state which contributes about one-third of India's sillimanite. The beach sands of Kerala contain 5 to 6 per cent of sillimanite. Kozhikode, Palakkad, Ernakulam and Kottayam districts are major producers. In **Maharashtra** all grades of sillimanite have been reported from the Bhandara district, where the reserves are reported to be of the order of 2,32,055 tonnes. Small quantity of sillimanite is produced in **Rajasthan** also. Udaipur is the main producing district. **Karnataka** has about 85 thousand tonnes reserves of sillimanite mainly in Hassan, Mysore and Dakshin Kannad. The recoverable reserves in **Meghalaya** are estimated to be 77,246 tonnes of all grades mainly confined to the Khasi hills. The other areas with some sillimanite reserves are **Assam** (Karbi-Anglong), **Madhya Pradesh** (Sidhi), **West Bengal** (Darjeeling, Bankura and Purulia) and **Tamil Nadu** (Kanniyakumari, Tirunelveli, Tiruchchirappalli).

Gypsum

Gypsum is a hydrated sulphate of calcium which occurs as white opaque or transparent mineral in beds or bands in sedimentary formations such as limestones, sandstones and shales. In some cases it occurs as transparent crystals associated with clays. It is mainly used in making ammonia sulphate fertilizer and in cement industry. It is an essential constituent of cement, though its proportion is only 4-5 per cent. It is also used in making plaster of Paris, moulds in ceramic industry, nitrogen chalk, partition blocks, sheets, tiles, plastics, etc. It is conveniently applied as surface plaster in agriculture for conserving moisture in the soil and for aiding nitrogen absorption.

The total resources of mineral gypsum in the country are estimated at 1,286 million tonnes of which 39 million tonnes have been placed under 'reserve' and 1,247 million tonnes under 'remaining resources' category. Of the total resources, fertilizer/pottery grade accounts for about 82 per cent and cement/paint grade 12 per cent. The unclassified and not-known grades together account for 5 per cent resources. The remaining one per cent of resources is shared by surgical plaster and soil reclamation grades. Of the states, Rajasthan alone accounts for 81 per cent resources and Jammu and Kashmir 14 per cent resources. The remaining 5 per cent resources are in Tamil Nadu, Gujarat, Himachal Pradesh, Karnataka, Uttarakhand, Andhra Pradesh and Madhya Pradesh.

Table 23.16 shows that there have been wide temporal variations in the production of gypsum in India. It increased rapidly from 984 thousand tonnes in 1980-81 to 3,877 thousand tonnes in 2008-09, reached its peak to 4,347 thousand tonnes in 2010-11 and fell to 3,480 thousand tonnes in 2011-12 (**Table 23.16**).

TABLE 23.16. Production of Gypsum in India (thousand tonnes)

Year	Production
1980-81	948
2008-09	3,877
2009-10	3,370
2010-11	4,347
2011-12	3,480

Source : Statistical Outline of India (Tata), 2012-13, p. 67.

Rajasthan is by far the largest producer of gypsum in India. This state produced 3,159.7 thousand tonnes of gypsum in 2011-12 which was over 90 per cent of India's production. The total recoverable reserves of all grades of gypsum in Rajasthan are of the order of 1055 million tonnes. The main deposits occur in the Tertiary clays and shales of Jodhpur, Nagaur and Bikaner. Jaisalmer, Barmer, Churu, Pali and Ganganagar also have some gypsum bearing rocks. The remaining gypsum is produced by Tamil Nadu, Jammu and Kashmir, Gujarat and Uttar Pradesh in order of production. **Tamil Nadu** has most of its deposits in Tiruchirapalli district between Chittali in the north and Tappay and Periyakurukhai in the south. Some gypsum is also reported from Coimbatore district. Minor occurrences are found along the coast and in some salt pans in Nellai Kattabomman, Ramanathapuram, South Arcot Vallalar and Chingleput districts. The recoverable deposits are estimated to be 16.35 million tonnes. **Jammu and Kashmir** has estimated reserves of 112.9 million tonnes. The main deposits occur in Baramula and Doda districts and in Uri. **Gujarat** has total reserves of 10.3 million tonnes mainly confined to Bhavnagar, Junagadh, Jamnagar and Kachchh districts. Minor deposits occur in Kheda and Surendranagar districts. In **Uttarakhand**, the main deposits of gypsum are found in Tehri Garhwal, Dehra Dun and Musoorie.

Some gypsum is also produced in **Andhra Pradesh,** (Nellore, Guntur, Prakasam), **Himachal Pradesh** (Spiti, Sirmur, Chamba), **Karnataka** (Gulbarga) and **Madhya Pradesh** (Shahdol).

In addition to mineral gypsum, water and phosphoric acid plants are important sources of by product gypsum. Marine gypsum is recovered from salt pans during the processing for common salt in coastal regions particularly of Gujarat and Tamil Nadu. Phospho-gypsum is obtained as a by-product while manufacturing phosphoric acid whereas fluro-gypsum is obtained while manufacturing aluminium flouride and hydro-fluoric acid. Similarly, boro-gypsum is the by-product of refining calcium borates. It is worth mentioning that the recovery of by-product phospho-gypsum, fluoro-gypsum, and marine gypsum together is higher than mineral gypsum.

Diamonds

Diamonds have been highly valued and cherished throughout the ages because of their brilliance, adamantine, lustre, transparency and hardness. They are widely used for ornaments and for polishing the surface metals, minerals and gem cutting. The most important industrial use of diamonds is in cutting-edges of drills used for exploration and mining of minerals.

The production of diamonds had increased from 1,674 carats valued at ₹ 5.34 lakh in 1950 to 18,489 carats valued at ₹ 19.8 crore in 2011-12. The main diamond bearing areas are Panna belt in Madhya Pradesh; Wajrakarur Kimberlite pipe in Anantapur district and the gravels of the Krishna river basin in Andhra Pradesh. Reserves have been estimated only in Panna belt and Krishna Gravels in Andhra Pradesh. The total *in situ* reserves are about 26,43,824 carats. There are conditional resources of 19,36,512 carat. The new kimberlite fields are discovered recently in Raichur-Gulbarga districts of Karnataka. Further investigations for diamonds are being carried out in Andhra Pradesh, Madhya Pradesh and Karnataka.

Reserves of diamonds in India are not yet exhausted and modern methods are being applied for intensive prospecting and mining in Panna, Kurnool, Bellary and some other selected places in central India.

Indian diamonds are in great demand in the international market, especially for jewellery. Cutting and polishing of diamonds is done by modern techniques at important centres like Surat, Navasari, Ahmedabad, Palampur, Bhavnagar and Mumbai. Khambhat, Jaipur, Trichur and in Goa state are comparatively new centres.

Atomic Minerals

Uranium and Thorium are the main atomic minerals to which many be added *i.e.*, beryllium, lithium and zirconium. Uranium is perhaps the only chemical element that has been dominating the world strategic scene since the mid-twentieth century. Discovered more than 200 years ago in mineral known as pitchblende by a German chemist Martin Heinrich Klaproth, it derives its name from the planet Uranus, which was discovered only a few years earlier in 1781. Henry Beaquerel, a French physicist discovered the new property of radioactivity in uranium which opened a new era in nuclear technology. Later it was discovered that uranium with atomic number 92 occurs in nature in two principal isotopic farms of mass number U-238 (99.3%) and U-35 (0.7%). Uranium occurs in the earth crust with average concentrations 2 to 4 ppm (parts per million) and in sea water with average concentration 0.003 ppm. It occurs with much higher concentration in

certain minerals like uraninite, pitchblende, autunite and uranophane. Australia is said to have largest deposits of uranium which amount to about 11,42,000 tonnes (about 30% of the world deposits). This is followed Kazakhistan, Canada, U.S.A., South Africa, Namibia, Brazil, Niger and Russia. The world production of uranium at present is in the vicinity of forty thousand tonnes. Canada with 25% of the world production is at the top followed by Australia, Kazakhistan and some other countries.

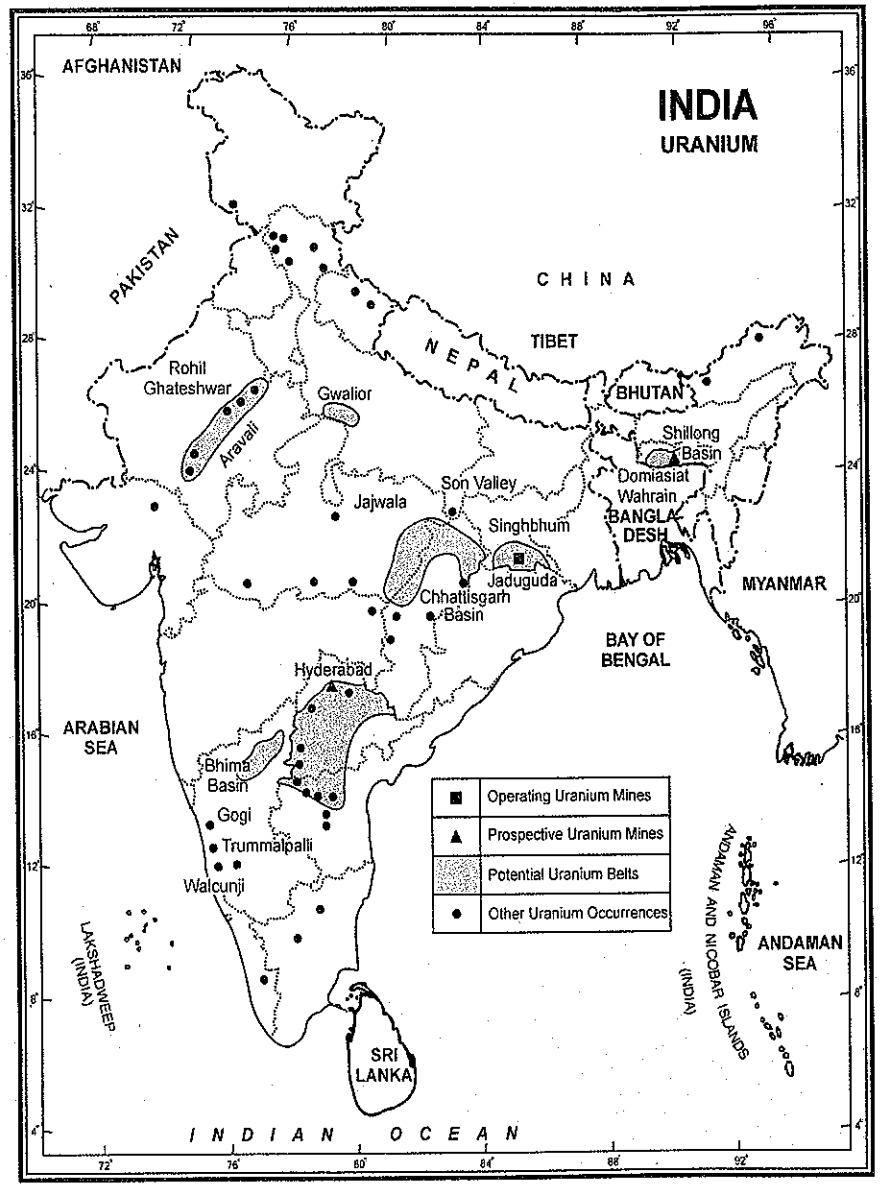

FIG. 23.7. India : Uranium

In India, the Atomic Mineral Directorate (AMD) set-up under the Department of Atomic Energy (DAE), is responsible for geological exploration to discover mineral deposits like uranium, thorium, and others like zirconium, beryllium, lithium, etc. These minerals provide necessary base for nuclear industry. Modern techniques like satellite pictures and aerial survey are employed to delineate geological formations containing these minerals. Commercial exploitation of atomic minerals is done by the Uranium Corporation of India Limited.

One kg of uranium can produce as much electricity as is done by 1,500 tonnes of coal.

The first uranium deposit was discovered in 1951 at Jaduguda in Jharkhand and the mine was commissioned in 1967. Three more mines have been established in Jharkhand one each in Narwapahar (1995), Turamdih (2002) and Bagjata (2007). The other major deposits have been found at Bodal in Chhattisgarh and Jajawal in Madhya Pradesh; Domiasiat (known to be one of the largest and richest), Wahkyn and Tyrani in Meghalaya and Lambapur-Peddagattu and Tummalapalle in Andhra Pradesh. Favourable uranium mineralization has also been identified at Gogi in Karnataka, Kuppam and Gandi in Andhra Pradesh, Rohil in Rajasthan, Bastar district in Chhattisgarh and many other places.

The mixed mineral ore is processed at uranium mills at Jaduguda, Batin and Narwapahar where it is converted into uranium oxide (U_3O_8), popularly known as "Yellow Cake".

According to Department of Atomic Energy (DAE) India has the capacity to generate 21,180 megawatts of electricity by 2020. The country has an estimated uranium oxide reserve 11,17,800 metric tonnes in six states (**Table 23.17**).

TABLE 23.17. Distribution of Uranium reserves (2011-12)

State	Uranium reserves (metric tonnes)
1. Jharkhand	46,700
2. Andhra Pradesh	22,000
3. Karnataka	21,000
4. Meghalaya	16,400
5. Rajasthan	2,900
6. Chattisgarh	2,800
Total	1,17,800

Source : Department of Atomic Energy.

A study of samples of magnetic rocks from the Nubra-Shyok valley in Lakakh has found uranium (0.31-5.36 per cent) and thorium (0.76-1.43 per cent). The study made in the isotope laboratory of the University of Tuebingen in Germany in 2007 says that uranium found in these rocks is exceptionally high when compared with 0.1 per cent or even less in ores present elsewhere in the country.

Timeline

1951 : Uranium deposits discovered in Jaduguda.

1956 : Uranium found in Umbra, Rajasthan.

1957 : Exploratory mining begins in Umbra and Jaduguda.

1962 : Exploratory mining in Bhatin (Jharkhand); Narwapahar the next year.

1973: Deposits discovered in Bodal, Chhattisgarh.

1979 : Evaluation and resource estimation of Bhatin, Turamidih (East) Deposits completed Discovery of spondumene bearing tantaliferous pegmatite at Mariagalla, Karnataka.

1984 : Deposits found at Domiasiat, Meghalaya.

1985 : Evaluation and resource estimation of Bodal completed.

1986 : Discovery of dolostone-hosted uranium mineralisation in Tummalapella, Andhra.

1987 : Evaluation and resource estimation of Turamdih (West) deposit completed.

1989 : Evaluation and resource estimation of Mohuldih deposit (Jharkhand) completed.

1991 : Discovery in Lambapur, Andhra.

1992 : Test recovery plant set up in Domiasiat for uranium extraction.

1993 : Evaluation and resource estimation of Domiasiat completed.

1994 : Find in Wahkyn, Meghalaya.

1997 : Discovery of Gogi, Karnataka.

2001 : Evaluation and resource estimation of Lambapur-Peddagattu deposit (Andhra) completed.

However, the largest source of uranium comprise the monazite sands, both beach and alluvial. Although monazite sands occur on east and west coasts and in

some places in Bihar, the largest concentration of monazite sand is on the Kerala coast. Over 15,200 tonnes of uranium is estimated to be contained in monazite. Some uranium is found in the copper mines of Udaipur in Rajasthan.

Thorium is also derived from monozite which contains 10 per cent thoria and 0.3 per cent urania. The other mineral carrying thorium is thorianite. The known reserves of thorium in India are estimated to be between 4,57,000 and 5,08,000 tonnes. Kerala, Jharkhand, Bihar, Tamil Nadu and Rajasthan are the main producers.

Beryllium oxide is used as a 'moderator' in nuclear reactors for atomic power generation. India has sufficient reserves of beryllium to meet her requirement of atomic power generation.

Lithium is a light metal which is found in lepidolite and spodumene. Lepidolite is widely distributed in the mica belts of Jharkhand, Madhya Pradesh and Rajasthan as well as in Bastar region of Chhattisgarh, ***Zirconium*** is found along the Kerala coast and in alluvial rocks of Ranchi and Hazaribagh districts of Jharkhand.

Salt

It is an important mineral which is used in chemical industry. Sodium chloride, known as *common salt*, is used as a food item. Salt is obtained from sea water, brine springs, wells and salt pans in lakes and from rocks. Rock salt is taken out in Mandi district of Himachal Pradesh and in Gujarat. It is less than 1 per cent of the total salt produced in India. Sambhar lake in Rajasthan produces about 10 per cent of our annual production. Sea brine is the source of salt in Gujarat, Maharashtra and Tamil Nadu. Gujarat coast produces nearly half of our salt. Production of salt in India increased from 30 lakh tonnes in 1951 to 100 lakh tonnes in 2011-12. In 2005-06, 1,871 tonnes rock salt worth ₹ 29.54 lakh was produced.

CONSERVATION OF MINERAL RESOURCES

Conserving the mineral resources is the most serious problem because they are exhaustible resources. Once taken out of the mines, minerals are used for ever. This is the reason that mining is often called a *robber industry*.

The mineral resources are being exploited at an accelerated rate due to advancement in mining technology. India exports a large number of minerals to earn the much needed foreign exchange. But it will be much better if we export goods manufactured from the minerals rather than exporting minerals in their raw form. Minerals can be conserved by bringing in efficiency in mining technology as well as in the technology of benefication. There are many 'cyclic' minerals such as iron, aluminium, copper, brass, tin, etc. Recycling of these minerals can help in reducing the waste. Japan, Britain, Italy, etc. are some of the countries which are using scrap iron on a large scale for iron and steel industry. Scarce minerals may be saved by substituting them by those minerals which are cheaper and are found in abundance. The best example is that of aluminium which is now extensively used in electrical industry in place of copper.

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Energy Resources

Energy is the primary input in the production of goods and services. *The wheels of progress move with the flow of energy*. One of the critical elements in raising the standard of living of a country's population is the provision of affordable and reliable energy services in sufficient quantities. More regular and ample is the availability of energy, more even will be the path to economic prosperity. The role of energy has significantly increased with the increase in industrialization and urbanization in the present day society. From its early role, which was confined to kitchen as a fuel for household cooking, energy is now a major input in sectors such as industry, commerce, transport and telecommunications, besides the wide range of services required in the household sector.

Depending upon its source and utilization, energy can be divided into two broad classes *viz.* (*i*) *traditional or non-commercial*, and (*ii*) *commercial energy*. The non-commercial energy includes fire-wood, charcoal, cow dung, agricultural wastes and also animal power. The commercial sources of energy comprise coal, oil, natural gas, hydro-electricity, nuclear power, as well as wind and solar power. Energy may also be classified as *conventional* and *non-conventional* depending upon its nature. Coal, petroleum, natural gas and electricity are the main sources of *conventional energy* while solar, wind, tidal, geothermal energy and biogas, etc. are some of the outstanding examples of *non-conventional energy*.

CONVENTIONAL SOURCES OF ENERGY

As mentioned in the preceding paragraph, coal, petroleum, natural gas and electricity are conventional sources of energy. A brief description of their production, distribution and consumption is given in the following pages.

COAL

Coal is an inflammable organic substance, composed mainly of hydrocarbons, found in the form of sedimentary rocks and capable of being used as fuel to supply heat or light or both. It also contains volatile matter, moisture and ash in varying proportions. Combustible matter in coal consists of carbon and hydrogen.

Coal was, is and will continue to be the main-stay of power generation in India for a longtime. It constitutes about 70 per cent of total commercial energy consumed in the country. The power sector and industries account for 94 per cent of total consumption. Manufacturing of iron and steel and a variety of chemicals largely depend upon the availability of coal. Due to its high utility as a source of energy and as a raw material for a large number of industries, it is often called ***black gold***. A recent study conducted by energy experts shows that the world coal reserves are six times the known reserves of oil and coal has been described as the *bridge into the future*.

Origin of Coal

Coal has originated from the organic matter wood. Large tracts of forest lands were buried under sediments in the geological past *i.e.* in the Carboniferous age. Wood was burnt and decomposed due to heat from below and pressure from above. During the process of decomposition of wood, hydrogen originates in the form of methane and water, oxygen in the form of carbon dioxide and water. During the process of change from wood to coal, the amount of oxygen and nitrogen decreases and the proportion of carbon increases. The capacity of coal to give energy depends upon the percentage of carbon contained in it. The percentage of carbon in coal depends upon the duration and intensity of heat and pressure on wood.

Varieties of Coal

Depending upon its grade from highest to lowest, following four varieties of coal are generally recognized.

1. Anthracite Coal. This is the best quality of coal and contains 80 to 95 per cent carbon. It has very little volatile matter and negligibly small proportion of moisture. It is very hard, compact, jet black coal having semi-metallic lustre. It ignites slowly and burns with a nice short blue flame. It has the highest heating value and is the most prized among all the varieties of coal. In India, it is found only in Jammu and Kashmir and that too in small quantity.

2. Bituminous Coal. This is the most widely used coal. It derives its name after a liquid called bitumen released after heating. It varies greatly in composition-in-carbon content (from 40 to 80 per cent)–and moisture and volatile content (15 to 40 per cent)–so that it is often sub-divided into several minor divisions such as sub-bituminous and bituminous coals. It is dense, compact, and is usually of black colour. A good bituminous coal is composed of alternate dull and bright bands. It does not have traces of original vegetable material from which it has been formed. Its calorific value is very high due to high proportion of carbon and low moisture content. By virtue of this quality, bituminous coal is used not only for steam raising and heating purposes but also for production of coke and gas. Most of the bituminous coal is found in Jharkhand, Odisha, West Bengal, Chhattisgarh and Madhya Pradesh.

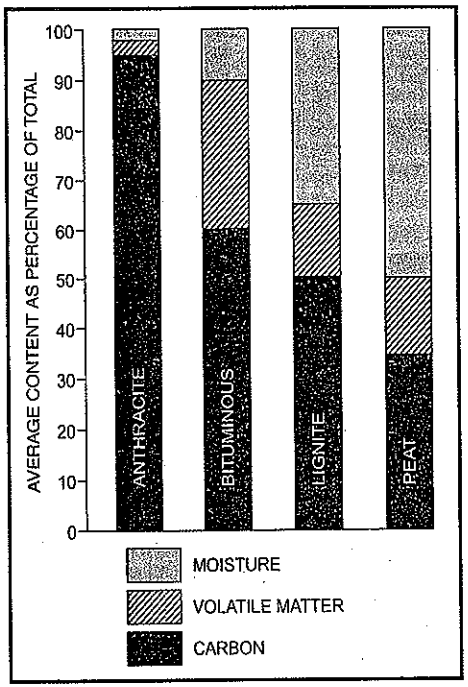

FIG. 24.1. Constituents of different types of coal

3. Lignite. Also known *as* ***brown coal***, lignite is a lower grade coal and contains about 40 to 55 per cent carbon. It represents the intermediate stage in the alteration of woody matter into coal. Its colour varies from dark to black brown. It is friable and pyritious. Its moisture content is high (over 35 per cent) so that it gives out much smoke but little heat. Its typical qualities make it liable to disintegrate on exposure and even to spontaneous combustion. It is found in Palna of Rajasthan, Neyveli of Tamil Nadu, Lakhimpur of Assam and Karewa of Jammu and Kashmir.

4. Peat. This is the first stage of transformation of wood into coal and contains less than 40 to 55 per cent carbon, sufficient volatile matter and lot of moisture. It is seldom sufficiently compact to make a good fuel without compressing into bricks. Left to itself, it burns like wood, gives less heat, emits more smoke and leaves a lot of ash after burning.

Occurrence of Coal in India

The coal bearing strata of India are geologically classified into two main categories, *viz.*, the Gondwana coal fields and the Tertiary coal fields.

(a) **Gondwana Coal.** Gondwana coal contributes overwhelmingly large proportion of both the reserves and production of coal, accounting for 98 per cent of the total reserves and 99 per cent of the production of coal in India. It is the store house of India's metallurgical as well as superior quality coal. Of the 113 major coal fields found all over India, 80 are located in the rock systems of the lower Gondwana Age. There are about 75 separate basins covering an area of 77,700 sq km mainly confined to the Peninsular India. The size of these basins varies from 1 sq km to 1,550 sq km. These basins occur down in the valleys of certain rivers *viz.*, the Damodar (Jharkhand-West Bengal); the Mahanadi (Chhattisgarh-Odisha); the Son (Madhya Pradesh-Jharkhand); the Godavari and the Wardha (Maharashtra-Andhra Pradesh); the Indravati, the Narmada, the Koel, the Panch, the Kanhan and many more.

Gondwana coal is said to be about 250 million years old. It includes coking as well as non-coking and bituminous as well as sub-bituminous coal. Anthracite is generally not found in the Gondwana fields. The volatile compounds and ash (usually 13 to 20, rising to as much as 25 to 30 per cent) are present in too large a proportion to allow the carbon percentage to rise above 55 to 60; generally much less than that. The Gondwana coal is almost free from moisture, but it contains sulphur and phosphorus in small variable quantities.

It is possible that some coal bearing Gondwana rocks are hidden beneath the great pile of lava of the Deccan trap. At several places, chiefly in the Satpuras, denudation has exposed coal bearing Gondwana strata, from which it can be inferred that considerable quantities of valuable coal can be obtained from these areas. The Damuda series (*i.e.* Lower Gondwana) possesses the most valuable and best worked coalfields and accounts for about 80 per cent of the total coal production in India.

(b) **Tertiary Coal.** The tertiary rock system bears coals of younger age; from 15 to 60 million years and are mainly confined to the extra-Peninsula. This coal generally has low carbon and high percentage of moisture and sulphur. Important areas of Tertiary coal include parts of Assam, Meghalaya, Arunachal Pradesh, Nagaland, Himalayan foothills of Darjeeling in West Bengal, Jammu and Kashmir, Uttar Pradesh, Rajasthan, Kerala, Tamil Nadu and the union territory of Puducherry.

Reserves. According to the Geological Survey of India, the coal reserves of India as on 1 April, 2008 (down to a depth of 1,200 metre) have been estimated at 293.497 billion tonnes. State-wise distribution of coal reserves is given in **Table 24.1**.

TABLE 24.1. Distribution of Coal Reserves in India as on 1 January 2008

State	Total reserves in million tonnes	Percentage of all India reserves
1. Jharkhand	75,460.14	28.53
2. Odisha	65263.34	24.67
3. Chhattisgarh	44,134.04	16.68
4. West Bengal	28,334.84	10.71
5. Madhya Pradesh	20,559.96	7.77
6. Andhra Pradesh	18,696.59	7.07
7. Maharashtra	9,818.09	3.71
8. Others	226.06	0.86
Total	**2,64,535.06**	**100.00**

Source : Data computed from India 2009, A Reference Annual, p. 637.

The **table 24.1** shows that the distribution of coal reserves is highly uneven. Over four-fifths of coal reserves are concentrated in just four states of

Jharkhand, Odisha, Chhattisgarh and West Bengal. Jharkhand and Odisha have more than half of the coal reserves of India.

Lignite. As on 1 April, 2010, the total reserves of lignite in India have been estimated at 38.7 billion tonnes by Geological Survey of India. Over 90 per cent of the reserves of lignite are concentrated in Tamil Nadu. Neyveli area of Cuddalore district in Tamil Nadu has 4,150 million tonnes of lignate reserves out of which 2,360 million tonnes has been proved. The other lignite reserves of considerable importance in Tamil Nadu are those of Jayamkondacholapuram of Trichy district, Mannargudi and East of Veeranam. Lignite reserves have been identified in Rajasthan, Gujarat, Jammu & Kashmir and Kerala to the extent of 3,099 million tonnes, 1,778 million tonnes, 128 million tonnes and 108 million tonnes respectively.

Production

Although the first coal mine was opened in 1774 at Raniganj in West Bengal, the real beginning was made in 1814 in the same area. Coal mining industry registered a much faster growth after Independence (see **Table 26.2**).

The production rose steadily from 119.02 million tonnes in 1980-81 to 609.82 million tonnes in of coal and lignate.

The nationalisation of coal industry in 1973-74 gave much needed impetus to coal and lignite production and India is now the third largest coal producer in the world after China and the USA. At present, the coal industry provides employment to nearly seven lakh persons.

Distribution of Coal in India

Majority of the coal-fields are found in the eastern part of India particularly to the east of 78° E longitude. Maximum concentration of coal fields is in the north-eastern part of the Peninsular plateau of India comprising parts of Jharkhand, Chhattisgarh, Odisha and eastern Madhya Pradesh and western part of West Bengal adjoining Jharkhand. Southern part of Madhya Pradesh, eastern part of Andhra Pradesh and eastern part of Maharashtra also have large deposits of coal (**Fig. 24.3**).

Table 24.3 makes it clear that about three-fourth of India's coal is produced by four states of Chhattisgarh, Jharkhand, Odisha and Madhya Pradesh. More than 40 per cent of India's total coal production comes from just two states of Chhattisgarh and Jharkhand. About one-third of the total coal of the country is obtained from Andhra Pradesh, Maharashtra, West Bengal, Uttar Pradesh and Meghalaya.

TABLE 24.2. Production of Coal (including lignite) in India in million tonnes

Year	Cocking		Non-cocking	Total	Lignite	Total (coal + lignite)
	Metallurgical	Non-metallurgical				
1950-51	NA	NA	NA	32.30	NA	NA
1960-61	16.99	NA	38.14	NA	NA	NA
1970-71	17.82	NA	55.13	NA	3.39	NA
1980-81	24.59	8.03	81.29	113.91	5.11	119.02
1990-91	24.10	21.20	166.43	211.73	13.77	225.50
2000-01	19.31	11.70	278.55	309.63	22.95	332.58
2010-11	17.70	31.85	483.15	532.70	37.73	566.11
2011-12	16.24	35.42	488.29	539.95	42.33	582.28
2012-13	14.55	37.03	504.82	556.40	46.45	602.85
2013-14	—	—	507.42	565.64	44.18	609.82

NA = Data Not Available

Source : Economic Survey 2013-14, Statistical Appendix, p. A-26.

TABLE 24.3. Production of Coal in India 2011-12

State	Production in thousand times	Percentage of all India production
1. Chattisgarh	1,13,918	21.10
2. Jharkhand	1,09,702	20.32
3. Odisha	1,05,476	19.54
4. Madhya Pradesh	71,658	13.27
5. Andhra Pradesh and Telangana	52,210	9.69
6. Maharashtra	39,178	7.26
7. West Bengal	24,287	4.49
8. Uttar Pradesh	15,650	2.89
9. Odisha	7,773	1.44
Total	5,39,852	100.00

Source : Data computed from Mineral Wealth of India, 2013.

Gondwana Coalfields

As mentioned earlier, the Gondwana Coal fields are exclusively found in the Peninsular plateau of India. State-wise major Gondwana coal producing areas are described as under :

1. Chhattisgarh. Chhattisgarh holds the third position with respect to coal reserves but occupies the first position, so far as production is concerned. This state has 16.09 per cent of the coal reserves and produces over 21 per cent coal of India. Most of the coal fields of Chhattisgarh are located in the northern part of the state. The *Korba* coalfield stretches over an area of 515 sq km in the valleys of Hasdo (a tributary of the Mahanadi) and its tributaries (Ahram and Kurang) in Korba district. Coal occurs in the Barakar measures with total thickness of 700 m. Most of the coal from the field is sent to thermal power plant at Korba. The *Birampur* coalfield lies in Surguja district. With total reserves of 542 million tones this field has coal seams of thickness varying from 30 cm to 1.8 m. The *Hasdo-Arand* coalfield extends from Rampur in Surguja district to Arand valley in Bilaspur district and covers an area of about 1004 sq km. The coal reserves in this field are estimated at 4,321 million tonnes. The coal seams have average thickness of 2.5 m to 7.0 m. *Chirmiri* coalfield in Surguja district spreads over an area of 128 sq km. The total reserves of this field are estimated at 362 million tonnes. There are four coal seams in this field out of which three seams contain good quality coal. *Lakhanpur* coalfield lies south of Bisrampur coalfield and spreads over Surguja, Koriya, Korba and Bilaspur districts. Here the coal seams are 1 to 3 m thick. *Jhilmili* coalfield occupies a total area of 106 sq km. Being an extension of Sahagpur coalfield of Shahdol district (in Madhya Pradesh), most of it lies in Koriya district of Chhattisgarh. It has five coal seams which belong to Talcher and Barakar measures. The coal is non-cocking type and has high proportion of ash. *Johilla* coalfield, lying in the Johilla valley, covers an area of about 38 sq km. The reserves are estimated at 311 million tonnes. *Sonhat* coalfield in Surguja district has superior quality coal. Kutkona, Charch and Sardih coal bearing strata have high grade coal. *Tatapani-Ramkota* coalfields lie between Kanhar and Rehar rivers in the north-eastern part of Surguja district. Coal of Tatapani coalfields belongs to the Damuda series.

2. Jharkhand. Jharkhand is the richest state with respect to reserves but has conceded the first place to Chhattisgarh. This state was the largest producer of coal in India till recent past. Jharkhand has over 28 per cent of the coal reserves and produces more than 20 per cent coal of India. In the year 2011-12, Jharkhand produced 1097.02 lakh tonnes of coal.

Most of the coal fields are located in a narrow belt running in east-west direction almost along the 24°N latitude (Fig. 24.2). There are 21 prominent coal fields in Jharkhand of which 8 are in Dumka (Santhal Parganas), 7 in Hazaribagh and 3 each in Dhanbad and Palamu. Amongst these, Jharia, Bokaro, Girdih and Karanpura are outstanding. The *Jharia coal-field* lies to the south-west of Dhanbad city and covers an area of 453 sq km. It is one of the oldest and the richest coal fields of India and has been recognised as the ***store house*** of the best metallurgical coal in the country. The total estimates of all grades of coal upto a depth of 900 metre are estimated to be 16,985.69 million tonnes. The *Bokaro coal-field* in Hazaribagh district lies within 32 km of western end of the Jharia coal field. It is a long but narrow strip in the catchment area of the Bokaro river spreading over an area of 674 sq km. The entire Bokaro coalfield is divided into two parts *viz*. West Bokaro and East Bokaro. The reserves in West Bokaro upto a depth of

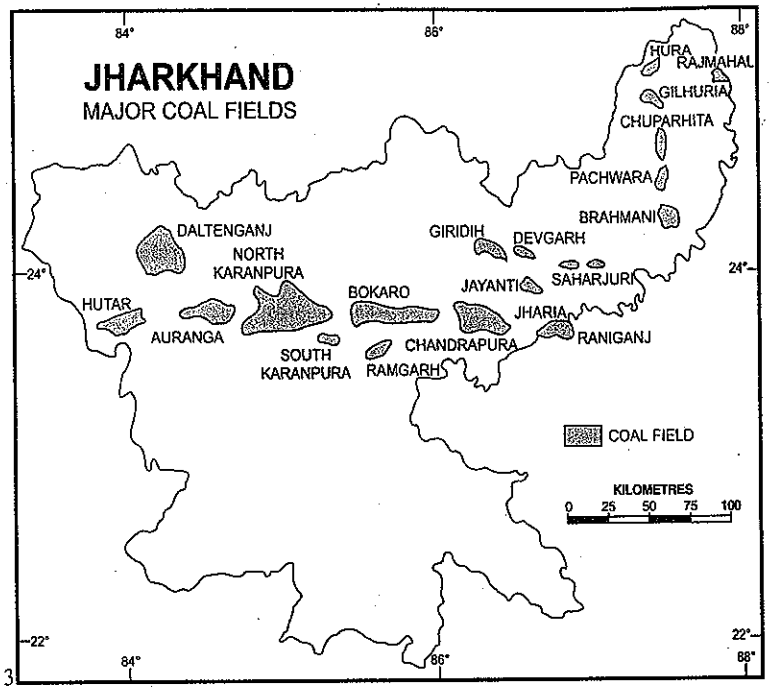

FIG. 24.2. Jharkhand : Major coal fields

900 metre have been estimated at 4,473.73 million tonnes with seams ranging from 3.5 to 11 metre thick. East Bokaro has 4,246.32 million tonnes of reserves upto a depth of 600 metre. The *Girdih* (also known as ***Karharbari***) coalfield lies to the south-west of Girdih in Hazaribagh district. Spreading over an area of 28.5 sq km this field has three main seams of varying thicknesses: (*i*) the Lower Karharbari (*ii*) the Upper Karharbari and (*iii*) the Badhua seams. The Lower Karharbari seam is 3 to 7.5 metre thick and gives out of the finest coking coal in India for metallurgical purposes. The *Karanpura and Ramgarh* coalfields lie to the west of Bokaro and cover an area of about 1,522 sq km. The *North Karanpura* covers an area of 1,230 sq km having estimated reserves of 13,110.84 million tonnes upto a depth of 900 metre. The *South Karanpura* field covers an area of 194 sq km and possesses estimated reserves of 5,757.85 million tonnes down to 900 metres in depth. *Ramgarh coal field* situated about 9 km away from the Bokaro field covers an area of 98 sq km having 22 seams. The total coal reserves of this field are estimated to be at 1,059.20 m tonnes down to a depth of 900 m. The *Auranga* coalfield in Palamu occupies an area of 240 sq km with a seam of 3 m thickness. Coal taken out from this field is of inferior quality which is used in cement furnaces and brick kilns. The *Hutar* coalfield, about 19 km west of Auranga field in Palamu district, covers an area of about 200 sq km with 5 seams of inferior coal. The *Deltenganj* coalfield in Palamu district covers a total area of 51 sq km. This field has proved reserves of 84 million tonnes. There are 14 coal seams near *Rajhera* whose thickness varies from 15 cm to 1.5 m. Devgarh coalfields lie in Dumka district where Jayanti, Saharjuri and Kundithuraih are the main mining areas. These coalfields occupy the valleys of the Adjai and Barakar rivers and covers a total area of about 46 km. *Jayanti* coalfields have 5 seams while the remaining two have two seams each. The coal here is of inferior quality and has high ash content. The *Rajmahal* coalfield along the western side of the Rajmahal hills is in a scathered form which spreads over an area of about 182 sq km. It lies in the north of the river where Hura, Gilhuria Chuparhita, Pachwara, Mahuagahi and Brahmki are important mines. This coalfield has proved coal

reserves of 1,913 million tonnes. However, coal available here is of inferior quality and is mostly used in brick kilns.

3. Odisha. Odisha is the second largest state with regard to coal reserves possessing 24.64 per cent of the total reserves of India but is the third largest producer of coal contributing a little over 19 per cent of the total coal production of the country. This means that there is a large scope for increasing coal production in this state. Most of the deposits are found in Dhenkanal, Sambalpur and Sundargarh districts. The *Talcher* field stretching eastward from

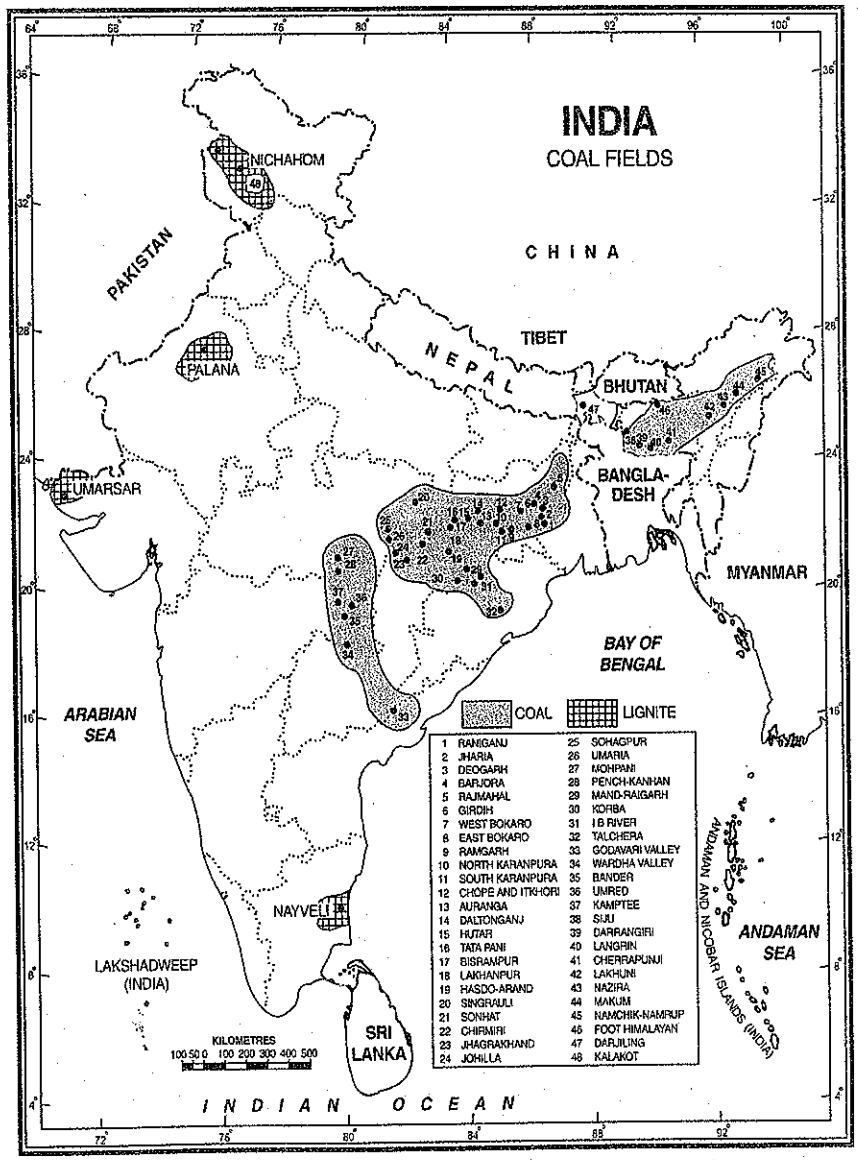

FIG. 24.3. India : Coal Fields

Talcher town to Rairkhol in Dhenkanal and Sambalpur districts ranks second in reserves (24,374 million tonnes) after Raniganj. This field covers an area of 578 sq km. Two workable seams of coal 3 to 4 metre thick had earlier been discovered in an area of 295 sq km near Talcher town. Coal from this field is most suitable for steam and gas production. Most of the coal is utilised in thermal power and fertilizer plants at Talcher. The *Rampur-Himgir* coalfields in the districts of Sambalpur and Sundargarh spread over an area of 520 sq km. Coal occurs here in middle and lower Barakar seams. Bulk of the coal is of inferior quality. The **Ib river** coalfield covers a total area of 512 sq km in Sambalpur and Gangpur districts. The inferred reserves in this area are estimated at 1,754 million tonnes. The coal belongs to the middle and lower Barakar systems in which Rampur, Lajkuria and Gamhadera seams are important. Much of the coal is of inferior quality with about 50 per cent fixed carbon.

4. Madhya Pradesh. Madhya Pradesh has about 7.77 per cent of the coal reserves but contributes about 13.27 per cent of the total coal production of India. Currently Madhya Pradesh is the fourth largest coal producing state of India. *Singrauli* (Waidhian) coalfield in Sidhi and Shahdol districts is the largest coalfield of Madhya Pradesh. Spreading over an area of 2,337 sq km, this coalfield has 9,207 million tonnes of coal reserves. Jhingurda, Panipahari, Khadia, Purewa and Turra are important coal seams. Jhingurda with a total thickness of 131 m is the richest coal seam of the country. This field supplies coal to thermal power plants at *Singrauli* and *Obra*. *Pench-Kanhan-Tawa* in Chhindwara district is another important coalfield of Madhya Pradesh. It contains 1956 million tonnes of semi-coking and non-coking coal. Ghoravari seam in Kanhan field is 4.6 m thick and contains coking coal. *Sohagpur* coalfield in Shahdol district has 2,284 million tonnes reserves of coal. Here coal seams attain a thickness of 3-5 m and even more. *Umaria* coalfield is situated at a distance of 58 km to the south of Katni. It contains 6 coal seams of which 4 are important (thickness 2 to 4 m). The total reserves are estimated at about 58 million tonnes. However, the coal is of inferior quality with high percentage of moisture and ash.

5. Andhra Pradesh and Telangana. With only 7.07 per cent of the reserves Andhra Pradesh and Telangana produce about 9.69 per cent of India's coal. Most of the coal reserves are in the Godavari valley spread over an area of 10,350 sq km in the districts of Adilabad, Karimnagar, Warangal, Khammam, East Godavari, and West Godavari. The actual workable collieries are situated at Tandur, Singareni and Kothagudam. Almost the entire coal is of non-coking variety. The reserves of all types of coal in the Godavari valley upto a depth of 1210 metre have been estimated at 10,435.50 million tonnes. These are the southern most coalfields of India and a source of coal supply to most of south India.

6. Maharashtra. Though Maharashtra has only 3 per cent reserves, the state accounts for over 7 per cent of the production of coal in India. Most of the coal deposits are found in the Kamptee coalfields in Nagpur District; Wardha valley, Ghughus, Ballarpur and Warora in Chandrapur district and the Wun field in Yavatmal district. Coal has also been located in Umrer, Nand, Makardhokra and Bokhara areas.

7. West Bengal. Although West Bengal produces just over four per cent of India's coal, the state has over 11 per cent of the coal reserves of the country. Barddhaman, Bankura, Purulia, Birbhum, Darjeeling and Jalpaiguri are the chief producing districts. Raniganj is the largest coalfield of West Bengal. In fact, it is at Raniganj that coal-mining started in India in 1,774. It covers an area of 1,500 sq km mainly in Barddhaman, Bankura and Purulia districts. Small part of this field is in Jharkhand state. This field produces mainly non-coking steam coal, which is mainly used by thermal power plants.

In Darjeeling district, coal reserves are found in Dalingkot coalfield; several seams occur near Tindharia where the best seam is about 3.3 metre thick. In Jalpaiguri district, a few seams are located near the Duars area.

8. Uttar Pradesh. Most parts of Uttar Pradesh are covered with sediment brought by rivers and do not possess coal reserves. But some of the coal seams of Madhya Pradesh project into the terrritory of this state. A small portion of the Singrauli field of Madhya Pradesh falls within Mirzapur district of Uttar Pradesh. A high grade coal seam, about 1 to 1.5 m thick occurs near Kotah.

Tertiary Coal-fields

Tertiary coal-fields mainly occur in association with limestone and slates of either Eocene or Oligocene-Miocene age. The statewise distribution of tertiary coal is as follows :

1. Assam. The major coalfields in Assam are the Makum, Nazira, Mikir Hills, Dilli-Jeypore and Lakhuni. Of these, the Makum coalfield in Sibsagar district is the most developed field. It is 28 km long and about 5 km wide. The total reserves of all types of coal in this field are estimated to be 235.6 million tonnes, down to a depth of 600 m. In the Mikir Hills coalfield, Koilajan, Langlor, Diogarang river areas are worth mentioning. Assam coals contain very low ash and high coking qualities but the sulphur content is high, as a result of which this coal is not suitable for metallurgical purposes. But these coals are best suited for hydrogenation process and are used for making liquid fuels.

2. Meghalaya. Garo, Khasi and Jaintia hills are believed to have deposits of tertiary coal belonging to lower Eocene. The total reserves of all types of coal in Meghalaya are estimated to be 459 million tonnes. The Garo hills have important coalfields near Darrangiri. In the Khasi and Jaintia hills, Siju, Cherrapunji, Liotryngew, Maolong and Langrin coalfields are important.

3. Arunachal Pradesh. The Upper Assam Coal belt extends eastwards as Namchick-Namrup coalfield in the Tirap district of Arunachal Pradesh. The seams of this coalfield are 4 to 19 metre thick. The coal is generally high in volatiles and in sulphur. The total reserves of all kinds of coal upto a depth of 330 m are estimated to be about 90 million tonnes.

The other tertiary coalfields include the Kalakot, Jangali, Chinkah, Metka, Maholgala and Ladde areas of Jammu and Kashmir and the Chamba district of Himachal Pradesh.

LIGNITE

That there has been a phenomenal increase in the production of lignite in India. Although lignite deposits are found in Tamil Nadu, Gujarat, Jammu and Kashmir, Kerala, Rajasthan, West Bengal and Puducherry; Tamil Nadu excels all other states regarding reserves and production of lignite.

1. Tamil Nadu. Tamil Nadu accounts for 90 per cent of the reserves and about 57 per cent of the production of lignite in India. This state produced 24,592 thousand tonnes of lignite out of a total of 42,897 thousand tonnes for the whole of India in 2011-12. The Neyveli Lignite fields of Cuddalore district, extending over an area of 480 sq km, have an estimated reserves of 4,150 million tonnes. These are the largest deposits of lignite in south-east Asia and can sustain power generation for more than a hundred years. However, Neyveli mines suffer from the artesian structure and constant pumping of water is a formidable task. Lignite reserves at Neyveli are exploited by Neyveli Lignite Corporation Limited (NLC). Incorporated as a private limited company in 1956, NLC was wholly owned by the Government and converted into a public limited company with effect from 7 March, 1986. Over the years, it has acquired considerable expertise and has established itself as a premier organisation in the field of lignite mining and lignite based power generation. Geological reserves of about 1,168 million tonnes of lignite have been identified in Jayamkondacholapuram of Trichy district of Tamil Nadu. In Mannargudi and east of Veeranam, geological reserves of around 22,898 million tonnes and 1,342.45 million tonnes have been estimated respectively.

TABLE 24.4. Distribution of Lignite in India 2011-12

State	Production in thousand times	Percentage of all India production
1. Tamil Nadu	24,592	57.33
2. Gujarat	14,761	34.41
3. Rajasthan	3,544	8.26
Total	42,897	100.00

Source : Data Computed from Mineral Wealth of India 2011-12.

2. Gujarat. Lignite occurs in Kachchh district at Umarsar, Lefsi, Jhalrai and Baranda and also in Bharuch district. The lignite of all the places except that of Umarsar is of poor quality. The total reserves of the state are estimated at 465 million tonnes. In 2011-12 Gujarat produced over 14.7 million tonnes of lignite which amounted to over 34 per cent of the total lignite production of India.

3. Rajasthan. Lignite deposits occur over an area 4 km long and 0.8 km wide at Palana in Bikaner district. Most of lignite is found at depths varying from 61 to 78 metres in 6 to 12 metre thick seams. Huge lignite reserves to the tune of 1,640 million tonnes were discovered in Barmer district in the year 2003. This discovery has made the state richer at total reserves of 2,300 million tonnes. The 250 MW thermal plant at Bikaner wholly depends upon lignite as the basic fuel. Lignite is found in some other parts of the state also. In 2011-12, Rajasthan produced 3,544 thousand tonnes of lignite which amounted to 8.26 per cent of total lignite produced in the country in that year.

4. Jammu and Kashmir. Lignite deposits belonging to Pliocene or even a newer age have been found here in sufficient quantity. The main lignite fields occur in the Shaliganga river, continuing to the northwest upto Nichahom area in Handwara region of Baramula district. The lignite here is of poor quality. The total reserves are 90 million tonnes.

5. Kerala. Irregular seams of lignite occur near Pathiarpally in Alappuzha district, Warkala in Thiruvananthapuram district and Paravur in Kollam district. But the main deposit of lignite occurs as a band of 45 to 60 cm thick near Kannur and Kasargod taluka. It is also found in Kozhikhode district.

6. West Bengal. Good quality lignite is reported to occur on the western side of the Jainti river and in Buza hills north-west of Jainti. Darjeeling and Jalpaiguri districts have small pockets of lignite. Beds of lignite also occur in the Ganga delta.

7. Puducherry. The total reserves of lignite in Puducherry are estimated at 250 million tonnes. The main deposits are reported from near Bahur, Araganur and Kanniyankovil. Pudukaddai, Vadapuram, Kadvanur and Paliayam also have some deposits.

PEAT

Peat is confined to a few areas only. It occurs in Nilgiri hills at an elevation of over 1,800 m. In the Kashmir valley, peat occurs in the alluvium of the Jhelum and in swampy grounds in higher valleys. In West Bengal peat beds at depths ranging from 2 to 11 metre have been noted in Kolkata and its suburbs. In the Ganga delta, there are layers of peat which are composed of forest and rice plants.

Problems of Coal Mining in India

Coal mining industry in India is facing a lot of problems. Some of the major problems confronting the coal mining are discussed as under :

1. The distribution of coal is uneven. The major coal producing areas are confined to Jharkhand, Chhattisgarh, Madhya Pradesh, Odisha and West Bengal. Most of north plains and western parts of India are devoid of coal. This involves high transport cost to carry a heavy commodity like coal over long distances. Consequently, the coal consuming industries have to pay much higher prices for coal.

2. Indian coal has high ash content and low caloric value. The ash content varies from 20 to 30 per cent and sometimes exceeds even 40 per cent. This reduces the energy output of coal and complicates the problem of ash disposal.

3. A large percentage of coal is taken out from underground mines where the productivity of labour and machinery is very low. This has stagnated at an output per man shift (OMS) of 0.55 tonnes for the last two decades despite massive investments made in modernisation of underground mines. The underground mines employ 80 per cent of the man power, but contribute only 30 per cent of the total output. The per tonne production cost has increased from ₹ 50 in 1973-74 to ₹ 550 in 2011-12.

4. There are heavy losses due to fires in the mines and at pit heads. Pilferage at several stages also adds to losses. This leads to hike in price of coal and sets off a vicious circle of price spiral in the economy.

5. Mining and utilisation of coal leads to serious problem of environmental pollution. The open cast mining ravages the whole area converting it into a rugged and ravinous land. The coal dust in mines and near pit-heads creates health hazards to workers and their families. The burning of coal in thermal plants and factories releases several toxic gases in the atmosphere. Safety measures against environmental pollution caused by mining and utilisation of coal are very costly and complicated and are beyond the reach of ordinary entrepreneurs.

Conservation of Coal

The misuse of good quality coal for burning into transport and industries, the short life of metallurgical coal, selective mining leading to large scale wastage of raw coal, frequent fires in mines and unscientific method of extraction of coal have been identified as important indications for conservation of coal in India. Conservation of coal implies that every bit of energy that can be obtained from coal must be obtained and every bit of by-product that can be recovered must be recovered. Conservation of coal is an integral part of mine planning and operation. Following measures are suggested for conservation of coal in India.

1. Coking coal should be used for metallurgical industry only.
2. Low grade coal should be washed and blended with superior quality coal in requisite proportion and used in industries.
3. Selective mining should be discouraged and all possible coal from the mines should be taken out.
4. New reserves should be discovered and new techniques should be adopted.
5. Small and uneconomic collieries should be amalgamated and be made economically viable units.

PETROLEUM OR MINERAL OIL

The word 'petroleum' has been derived from two Latin words Petra (meaning rock) and Oleum (meaning oil). Thus petroleum is oil obtained from rocks; particularly sedimentary rocks of the earth. Therefore, it is also called mineral oil. Technically speaking, petroleum is an inflammable liquid that is composed of hydrocarbons which constitute 90 to 95 per cent of petroleum and the remaining is chiefly organic compounds containing oxygen, nitrogen, sulphur and traces of organo-metallic compounds. Crude petroleum consists of a mixture of hydrocarbons—solid, liquid and gaseous. These include compounds belonging to the paraffin series and also some unsaturated hydrocarbons and small proportion belonging to the benzene group.

Utilisation of Petroleum

Petroleum and petroleum products are mainly used as motive power. It is a compact and convenient liquid fuel which has revolutionised transportation on land, in the air and on water. It can be easily transported from the producing areas to the consuming areas with the help of tankers and more conveniently, efficiently and economically by pipelines. It emits very little smoke and leaves no ash, (as is the case in coal utilisation) and can be used upto the last drop. It provides the most important lubricating agents and is used as an important raw material for various petro-chemical products.

Origin and Occurrence of Petroleum

Petroleum has an organic origin and is found in sedimentary basins, shallow depressions and in the seas (past and present). Most of the oil reserves in India are associated with anticlines and fault traps in the sedimentary rock formations of tertiary times, about 3 million years ago. Some recent sediments, less than one million years old also show evidence of incipient oil. Oil and natural gas originated from animal or vegetable matter contained in shallow marine sediments, such as sands, silts and clays deposited during the periods when land and aquatic life was abundant in various forms, especially the minor microscopic forms of flora and fauna. Conditions for oil formation were favourable especially in the lower and middle Tertiary period. Dense forests and sea organisms flourished in the gulfs, estuaries, deltas and the land surrounding them during this period. The decomposition of organic matter in the sedimentary rocks has led to the formation of oil. Though oil is mainly found in sedimentary rocks, all sedimentary rocks do not contain oil. An oil reservoir must have three pre-requisite conditions : (*i*) porosity so as to accommodate sufficiently large amounts of oil; (*ii*) permeability to discharge oil and/or gas when well has been drilled; (*iii*) the porous sand beds sandstone, conglomarates of fissured limestone containing oil should be capped by impervious beds so that oil does not get dissipated by percolation in the surrounding rocks. Oil on a commercial scale is usually found where the sedimentary rock strata are inclined and folded; in a sort of chamber or reservoir, in the highest possible situation *e.g.* crests of anticlines. Normally, oil is associated with water. Being lighter than water (specific gravity of 0.8 to 0.98), it collects in the anticlines or fault traps above the surface of water. Gas is still lighter and occurs above oil. Thus on drilling an oil well, one finds gas followed by oil,

although gas seepage is not always a sure indication of an oil reservoir.

As already mentioned, oil as well as natural gas in India occur in sedimentary rocks. About 14.1 lakh sq km or about 42 per cent of the total area of the country is covered with sedimentary rocks out of which about 10 lakh sq km form marine basins of Mesozoic and Tertiary times. Besides, the country has offshore areas having Mesozoic and Tertiary rocks of marine origin covering an area of 2.5 lakh sq km upto a depth of 100 metre and another area of 0.7 lakh sq km upto a depth between 100 and 200 metre. Thus the total continental shelf of probable oil bearing rocks amounts to 3.2 lakh sq km (*see* **Fig. 24.4**) The total sedimentary area including both on shore and offshore comprises 27 basins. The geological and geophysical studies have been conducted in 14 basins while exploratory drilling has been done in 9 basins. Mumbai High, the Khambhat Gulf and the Assam are the most productive areas.

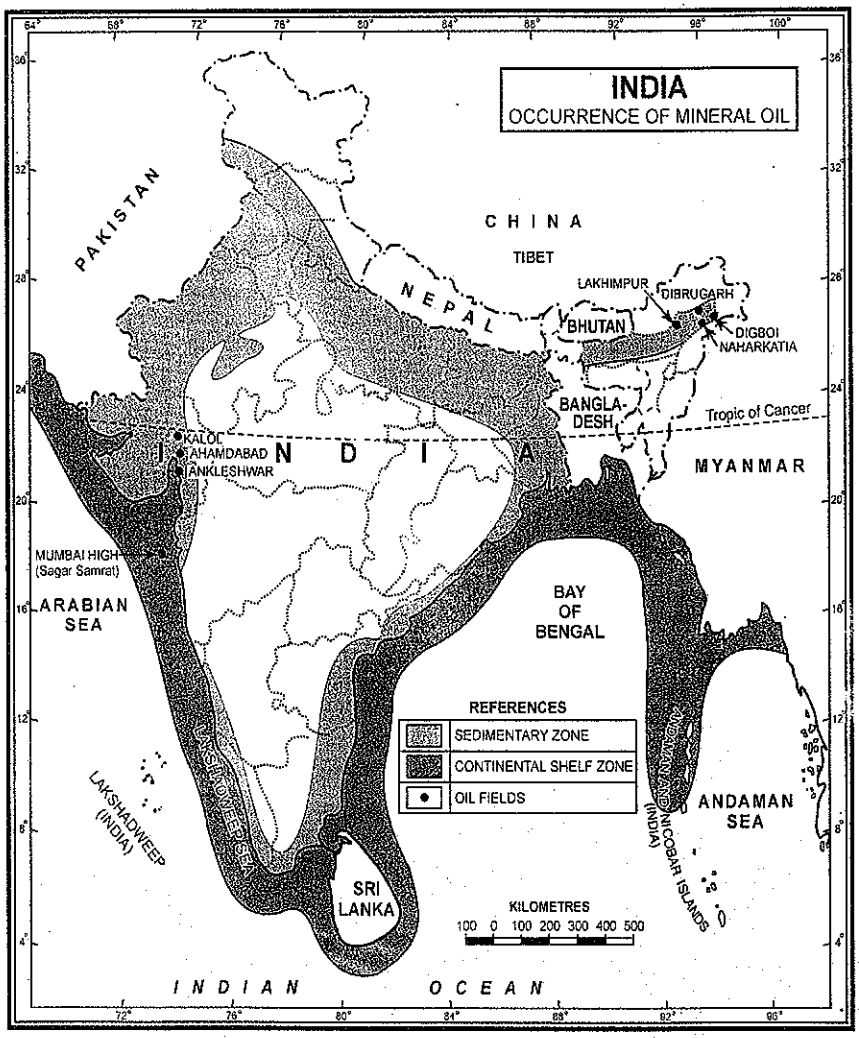

FIG. 24.4. India : Mineral Oil

TABLE 24.5. Production of Petroleum (Crude) in India (Million tonnes)

Year	1950 -51	1960 -61	1970 -71	1980 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12	2012 -13	2013 -14
On-shore	0.3	0.5	6.8	5.5	11.8	11.8	11.4	11.3	11.2	11.3	11.8	16.4	18.0	19.44	19.54
Off-shore	—	—	—	5.0	21.2	20.6	20.8	22.7	22.9	22.2	21.9	21.3	20.1	18.42	18.19
Total	**0.3**	**0.5**	**6.8**	**10.5**	**33.0**	**32.4**	**32.2**	**34.0**	**34.1**	**33.5**	**33.7**	**37.7**	**38.1**	**37.86**	**37.78**

Source : The Economic Survey, 2012-13, p. A-31 and Economic Survey 2013-14, Statistical Appendix, p. 27.

Production

India was a very insignificant producer of petroleum at the time of Independence and remained so till Mumbai High started production on a large scale. In fact, off-shore production did not start till the mid 1970s and the entire production was received from on-shore oil fields.

In 1980-81 about half of the production of crude oil came from on-shore fields while the remaining half was received from the off-shore resources. After that juncture, the off-shore production increased at a much faster rate than the on-shore production. From 1990-91 to 2009-10, about two-thirds of the production had been received from off-shore sources but after that on-shore production has picked up very fast. The total production recorded more than three times increase after 1980-81.

TABLE 24.6. Production of Petroleum (crude) in India 2011-12

State/Region	Production in thousand tonnes	Percenage of all India production
1. Off-shore	20,664	52.68
2. Rajasthan	6,553	17.20
3. Gujarat	5,774	15.16
4. Assam	5,023	13.19
5. Andhra Pradesh	305	0.81
6. Tamil Nadu	249	0.65
7. Arunachal Pradesh	120	0.31
All India	**38,088**	**100.00**

Source : Data computed from Mineral Wealth of India 2013.

As mentioned earlier, oil in India is obtained both from on-shore and off-shore areas, but off-shore areas made a major contribution (*see* **table 24.5** and **24.6**).

On-shore Oil Production. On-shore oil fields are located in the Brahmaputra valley of north-east India, Barmer area of Rajasthan, Gujarat coast in western India and Cauvery on-shore basin in Tamil Nadu. Besides Andhra Pradesh has both on-shore and off-shore oil reserves.

OILFIELDS IN NORTH-EAST INDIA

The major oilfields in north-east India are those of the Brahmaputra valley in Assam and its neighbouring areas including Arunachal Pradesh, Nagaland, Meghalaya, Tripura, Manipur and Mizoram.

Assam. Assam is the oldest oil producing state in India. The main oil bearing strata extend for a distance of 320 km in upper Assam along the Brahmaputra valley. Following are some of the important oilfields of Assam :

1. ***The Digboi field.*** Located in the north-east of Tipam hills in Dibrugarh district of Upper Assam, Digboi is the oldest oil field of India. The oil bearing strata cover an area of about 13 sq km where oil is available at 400 to 2,000 metre depth. Over 800 oil wells have been drilled so far. Before the opening of the oil fields of west India, Digboi used to account for three-fourths of the total oil production of India. The most important centres are Digboi, Bappapang, Hassapang and Paintola. Most oil is sent to oil refinery at Digboi.

2. ***The Naharkatiya field.*** It is located at a distance of 32 km southwest of Digboi at the left bank of Burhi Dihing river. Here oil was discovered in 1953 and production started in 1954. Oil is available at depths varying from 4,000 to 5,000 metres. Out of the 60 successful wells drilled so far, 56 are producing oil while the remaining 4 are producing natural gas. The annual production is 2.5 million tonnes of oil and one million cubic metre natural gas.

Oil from this area is sent to oil refineries at Noonamati in Assam (443 km) and Barauni in Bihar (724 km) through pipeline.

3. *The Moran-Hugrijan field.* It is located about 40 km south-west of Naharkatiya. Oil at Moran-Hugrijan field was discovered in 1953 and production started in 1956. Drilling has proved an oil bearing Barail horizon at a depth of 3,355 metre. Moran's potential may be estimated at one million tonnes per annum. As many as 20 wells have been drilled which yield oil as well as gas.

Other fields have been discovered at Rudrasagar, Sibsagar, Lakwa, Galeki, Badarpur, Barhoila and Anguri.

Oilfields of Assam are relatively inaccessible and are distantly located from the main consuming areas. Oil from Assam is, therefore, refined mostly in the refineries located at Digboi, Guwahati, Bongaigaon, Barauni and Numaligarh.

Arunachal Pradesh has oil reserves at Manabhum, Kharsang and Charali. In ***Tripura***, promising oilfields have been discoverd at Mamunbhanga, Baramura-Deotamura Subhang, Manu, Ampi Bazar, Amarpur-Dambura areas. ***Nagaland*** also has some oil bearing rock strata.

ON-SHORE OIL FIELDS OF WESTERN INDIA

Gujarat. Explorations by Oil and Natural Gas Commission (ONGC) have yielded valuable findings of oil bearing rock strata over an area of about 15,360 sq km around the Gulf of Khambhat. The main oil belt extends from Surat to Amreli. Kachchh, Vadodara, Bharuch, Surat, Ahmedabad, Kheda, Mahesana, etc. are the main producing districts. In 2011-12, Gujarat produced over 5774 thousand tonnes of crude oil which accounted for over 15 per cent of the total oil production of India. Ankleshwar, Lunej, Kalol, Nawgam, Kosamba, Kathana, Barkol, Mahesana and Sanand are the important oilfields of this region.

1. *Ankleshwar.* The first major oil-find came in 1958 with the discovery of Ankleshwar field located about 80 km south of Vadodara and nearly 160 km south of Khambhat. Ankleshwar anticline is about 20 km long and 4 km wide. Oil is available at depths varying from 1,000 to 1,200 metres. It has a capacity of 2.8 million tonnes per annum. It is such a prolific oilfield that Pt. Jawahar Lal Nehru called it the *fountain of prosperity*. As many as 170 oil wells have been bored so far. It is estimated that 25 lakh tonnes per year of oil can be obtained from this field. Oil from this field is sent to refineries at Trombay and Koyali.

2. *Khambhat or Lunej field.* The oil and Natural Gas Commission drilled test wells in 1958 at Lunej near Ahmadabad and confirmed the occurrence of a commercially exploitable oil field. Oil was obtained on 4th Sept. 1959. Till 1969, a total of 62 wells were drilled out of which 19 yielded gas while 3 yielded oil. The annual production is 15 lakh tonnes of oil and 8-10 lakh cubic metres of gas. The total reserves are estimated at 3 crore tonnes.

3. *Ahmedabad and Kalol field.* It lies about 25 km north-west of Ahmedabad. This field and a part of Khambhat basin contain 'pools' of heavy crude trapped in chunks of coal. Nawgam, Kosamba, Mahesana, Sanand, Kathana, etc. are important producers.

Oil has also been struck in Olkad, Dholka, Kadi, Asjol, Sandkhurd, Siswas, Nandesan, Bandrat, Sobhasan and Vadesar areas.

Rajasthan. One of the largest inland oil discoveries was made in Barmer district of Rajasthan in 2004. The oil block covers an area of approximately 5,000 sq km. State-of-the-art technology with innovative geological modelling was used in discovering this oil field. Initial estimates of the oil in place of this discovery range from 63 to 153 million tonnes. Two important discoveries, *viz.*, Sarswati and Rajeshwari, with a total 35 million tonnes of inplace oil reserves were made earlier in 2002. The Sarswati discovery had found 14 million tonnes of in place oil reserves for which drilling upto 3,476 m was done. Mangala oil field discovered in 2004 is the largest oil discovery since 1985. It has nearly one billion barrels of recoverable oil. In the year 2011-12, Rajasthan produced 6,553 thousand tonnes of oil which accounted for over 17 per cent of the total production. Thus Rajasthan became the largest off shore oil producing state of India surpassing Assam and Gujarat in quick succession.

WESTERN COAST OFF-SHORE OILFIELDS

Extensive surveys have been conducted by ONGC in the offshore areas of Kachchh, Khambhat, Konkan, Malabar and Coromandal coasts, Krishna-Godavari delta and Sunderbans. Success on commercial scale has been achieved at Mumbai High, Bassein and Aliabet.

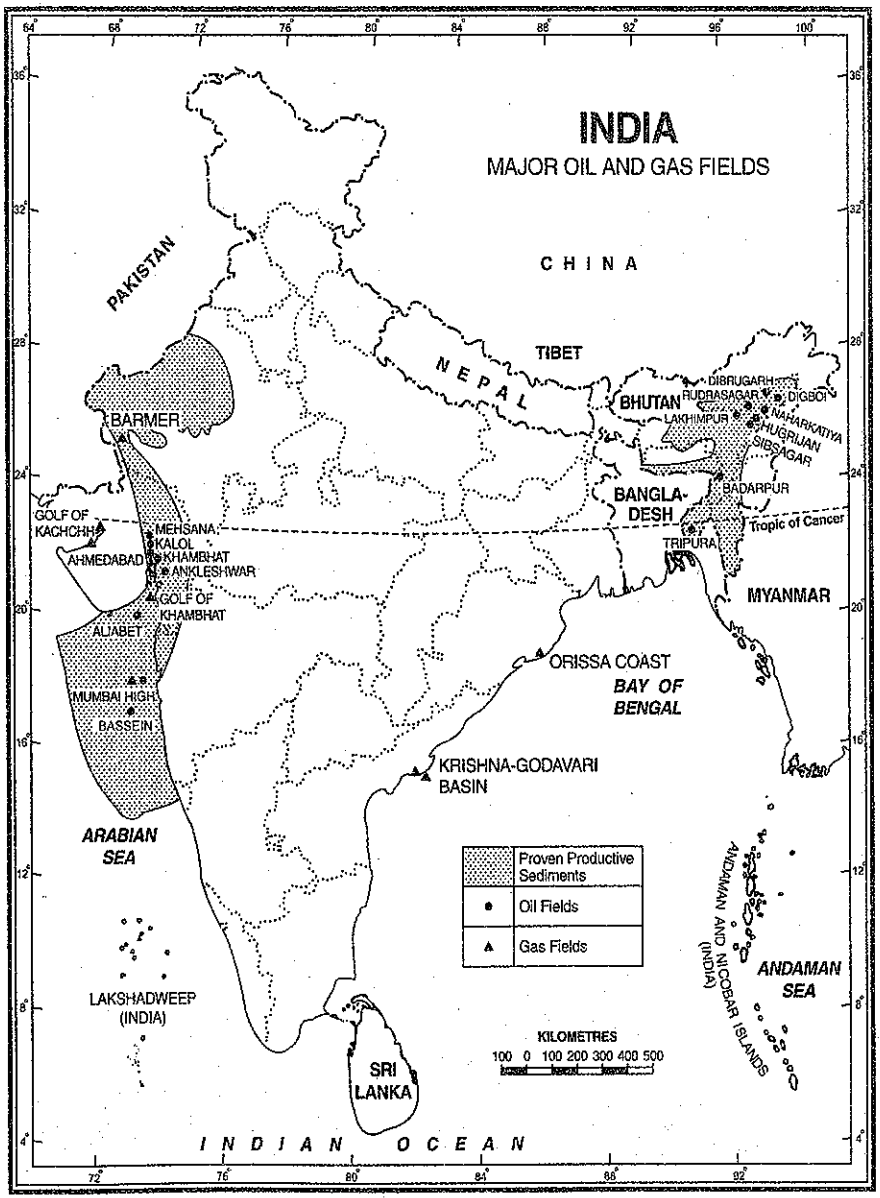

FIG. 24.5. India : Major Oil and Gas fields

1. Mumbai High. The greatest success achieved by the ONGC with respect to offshore surveys for oil was that of Mumbai High in 1974. It is located on the continental shelf off the coast of Maharashtra about 176 km north-west of Mumbai. Here the rock strata of Miocene age covers an area of 2,500 sq km with estimated reserves of about 330 million tonnes of oil and 37,000 million cubic metres of natural gas. Production on commercial scale began in 1976. Oil is taken from a depth of over 1,400 metre with the help of a specially designed platform known as ***Sagar Samrat.*** The discovery of Mumbai High has revolutionised the oil production in India. The share of Mumbai High in the total oil production of India has shot up considerably. This area produced 85 lakh tonnes of oil in 1982 which rose to over 189 lakh tonnes or over 62 per cent of all India in 1991-92. Production from this field declined between 1989-90 and 1993-94 due to over exploitation. Remedial measures have been taken to enhance the production and the declining trend has been reversed since 1994-95.

2. Bassein. Located to the south of Mumbai High, this is a recent discovery endowed with reserves which may prove to be higher than those of the Mumbai High. Huge reserves have been found at a depth of 1,900 metre. Production has started and has picked up fast.

3. Aliabet. It is located at Aliabet island in the Gulf of Khambhat about 45 km off Bhavnagar. Huge reserves have been found in this field. Commercial production is expected to start soon.

East Coast. The basin and delta regions of the Godawari, the Krishna and the Cauvery rivers hold great potential for oil and gas production. As such these are both on-shore and off-shore areas where extensive exploration has been conducted during the last few years. The Rawa field in Krishna-Godawari off-shore basin is expected to produce 1 to 3 million tonnes of crude oil annually.

Tamil Nadu produces less than the one per cent of the total oil production of India. The Narimanam and Kovilappal oilfields in the Cauvery on-shore basin are expected to produce about 4 lakh tonnes of crude oil annually. ***Andhra Pradesh*** also produces less than one per cent of the total crude oil of India. Oilfields have recently been discovered in the Krishna-Godavari basin. The oilfield near Amolpur is expected to yield 3,600 barrels of crude oil per day.

Probable Areas. There are vast possibilities of finding oil from about one lakh sq km area of sedimentary rocks in different parts of the country (see **Fig. 24.4**). Some of the outstanding areas which hold possibilities of oil are :

(*i*) Jawalamukhi, Nurpur, Dharamsala and Bilaspur in Himachal Pradesh.

(*ii*) Ludhiana, Hoshiarpur and Dasua in Punjab.

(*iii*) The Gulf of Mannar off the Tirunelveli coast.

(*iv*) The off-shore area between Point Calimere and Jaffna peninsula.

(*v*) Off-shore deep water area in Bay of Bengal between 12°N–16°N latitudes and 84°E–86°E longitudes.

(*vi*) The marine delta region of the Mahanadi, Godavari, Krishna and Cauvery rivers.

(*vii*) Stretch of sea between South Bengal and Baleshwar coast.

(*viii*) Off-shore area of the Anadaman and Nicobar Islands.

PETROLEUM REFINING

Oil extracted from the oil wells is in its crude form and contains many impurities. It is refined in oil refineries before use. After refining, various products such as kerosene, diesel, petrol, lubricants, bitumen, etc. are obtained. Although India's first oil refinery started working way back in 1901 at Digboi in Assam, it remained the only refinery in the whole of India for more than half a century. It was only in 1954 that another refinery at Tarapur (Mumbai) joined the lone refinery of Digboi. Since then oil refining in India has progressed at a rapid pace. In the recent past, Indian refining industry has done exceedingly well in establishing itself as a major player globally. India is emerging as a refinery hub and refining capacity exceeds the demand. The last decade has seen a tremendous growth in the refining sector. The country's refining capacity has increased from a modest 62 million metric tonnes per annum (MMTPA) in 1998 to 213.66 MMTPA at present, comprising 22 refineries—17 under public sector, 3 under private sector and 2 in joint venture. The capacity-wise details of the refineries are given below :

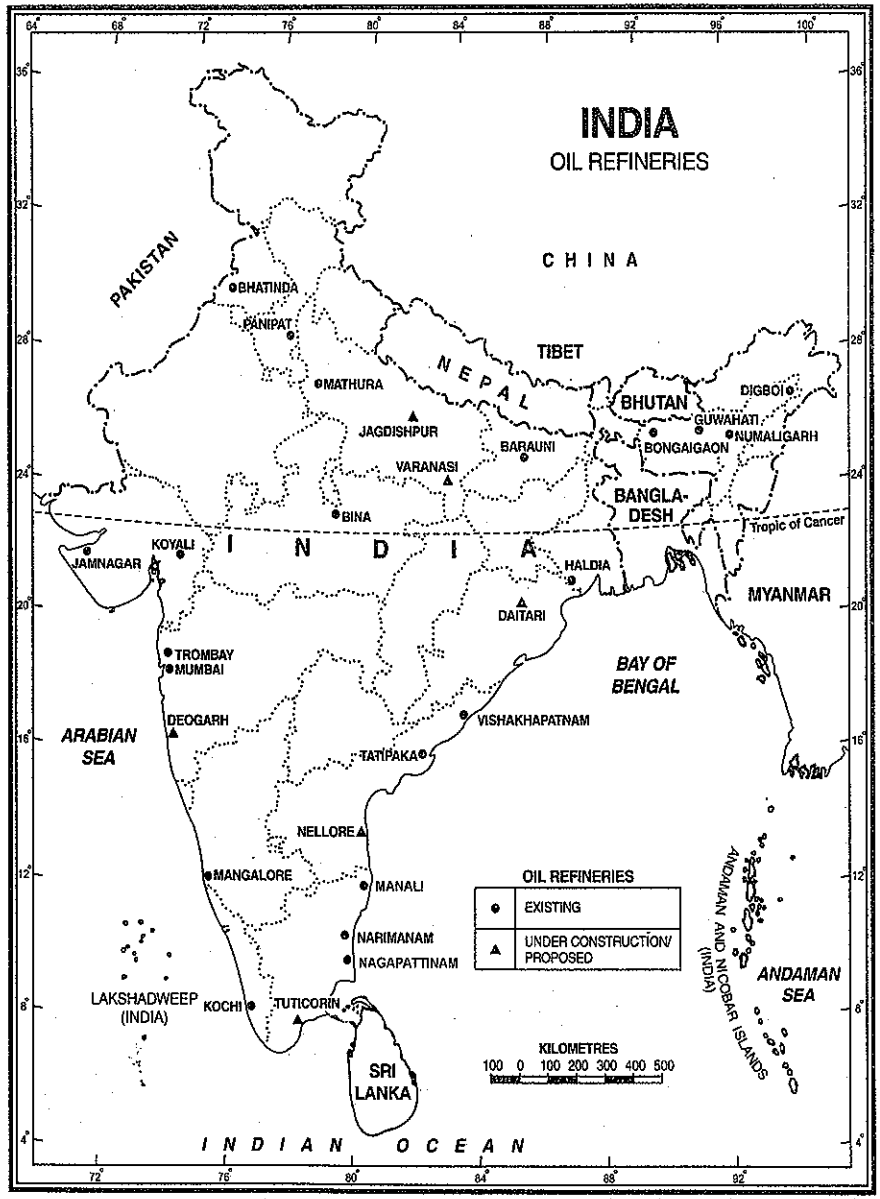

FIG. 24.6. India : Oil Refineries

TABLE 24.7. Details of Indian Refineries

Sl. No.	Refinery Location	Name of the Company	Name Plate Capacity (MMTPA)
	PSU Refineries		
1.	Guwahati		1.00
2.	Barauni		6.00
3.	Koyali		13.70
4.	Haldia		7.50
5.	Mathura	Indian Oil Corporation Ltd.	8.00
6.	Digboi		0.65
7.	Panipat		15.00
8.	Bongaigaon		2.35
9.	Mumbai	Hindusan Petroleum	6.50
10.	Visakhapatnam		8.30
11.	Mumbai	Bharat Petroleum Corporation Ltd.	12.00
12.	Kochi		9.50
13.	Manali	Chennai Petroleum	10.50
14.	Nagapattinam		1.00
15.	Numaligarh	Numaligarh Refinery Ltd.	3.00
16.	Mangalore	Mangalore Refinery Petrochemical Ltd.	15.00
17.	Tatipaka, AP	Oil & Natural Gas Corporation	0.66
		Total	**120.66**
	Jont Sector Refineries		
18.	Bina	Bharat Oman Refinery Ltd.	6.00
19.	Bathinda	HPCL Mittal Energy Ltd.	9.00
		Total	**15.00**
	Private Sector Refineries		
20.	Jamnagar	Reliance Industries Ltd.	33.00
21.	SEZ, Jamnagar		27.00
22.	Vadinar	Essar Oil Limited	18.00
		Total	**78.00**
		Grand Total	**213.66**

Source : India 2014 : A Reference Annual, p. 274.

PIPELINES

Pipelines are most convenient, efficient and economical mode of transporting liquids like petroleum, petroleum products, natural gas, water, milk, etc. Even solids can also be transported through pipelines after converting them into slurry.

Transportation by pipelines is a new development in India. Pipelines have relieved the increasing pressure on the existing surface transport system (railways and roadways).

The country had a network of about 5,035 km long pipelines in 1980 which has increased to over 7,000 km now. Pipelines have both advantages and disadvantages as described below.

Advantages of Pipeline. Pipelines have the following advantages over other means of transport :

1. They are ideally suited to transport the liquids and gases.
2. Pipelines can be laid through difficult terrains as well as under water.
3. It involves very low energy consumption.
4. It needs very little maintenance.
5. Pipelines are safe, accident-free and environmental friendly.

Disadvantages of Pipelines. Following are the main disadvantages of pipeline transport :

1. It is not flexible, *i.e.*, it can be used only for a few fixed points.
2. Its capacity cannot be increased once it is laid.
3. It is difficult to make security arrangements for pipelines.
4. Underground pipelines cannot be easily repaired and detection of leakage is also difficult.

Some of the important pipelines are briefly described as under :

1. Naharkatia-Nunmati-Barauni Pipeline. This was the first pipeline constructed in India to bring crude oil from Naharkatia oilfield to Nunmati. It was later extended to transport crude oil to refinery at Barauni in Bihar. It is 1,167 km long. It is now extended to Kanpur in U.P. The pipeline between Naharkatia and Nunmati became operative in 1962 and that between Nunmati and Barauni in 1964. Construction work on pipeline from Barauni to Kanpur and Haldia was completed in 1966. It has a number of pumping stations and subsidiary pipelines.

(*i*) Nunmati-Siliguri pipeline transport oil from Nunmati (Guwahati) in Assam to Siliguri in West Bengal.

(*ii*) Lakwa-Rudrasagar-Barauni pipeline has been constructed to carry crude oil from Lakwa and Rudrasagar to oil refinery at Barauni.

(*iii*) Barauni-Haldia pipeline, completed in 1966, transports refined petroleum products to Haldia port and bring back crude oil to Barauni refinery.

(*iv*) Barauni-Kanpur pipeline carries refined petroleum products from Barauni to Kanpur.

(*v*) Nunmati-Bongaigaon section of this pipe is used to transport raw materials for Bongaigaon petro-chemical complex.

(*vi*) Haldia-Rajbandh-Maurigram pipeline has been constructed to meet the requirements of southern part of West Bengal.

2. Mumbai High-Mumbai-Ankleshwar-Koyali Pipeline. This pipeline connects oilfields of Mumbai High and Gujarat with oil refinery at Koyali. A 210 km long double pipeline connects Mumbai with Mumbai High. It provides facilities for transporting crude oil and natural gas. Ankleshwar-Koyali pipeline was completed in 1965. It transports crude oil from Ankleshwar oilfield to Koyali refinery.

3. Salaya-Koyali-Mathura Pipeline. An important pipeline has been laid from Salaya in Gujarat to Mathura in U.P. via Viramgram. This is 1,256 km long pipeline which supplies crude oil to refineries at Koyali and Mathura. From Mathura, it has been extended to the oil refinery at Panipat in Haryana and further to Jalandhar in Punjab. It has an off-shore terminal for imported crude oil.

4. Hajira-Bijapur-Jagdishpur (HBJ) Gas Pipeline. This pipeline has been constructed by Gas Authority of India Limited (GAIL) to transport gas. It is 1,750 km long and connects Hazira in Maharashtra to Bijapur in M.P. and Jagdishpur in U.P. It carries 18 million cubic metres of gas everyday to three power houses at Kawas (Gujarat), Anta (Rajasthan) and Auraiya (U.P.) and to six fertilizer plants at Bijapur, Sawai Madhopur, Jagdishpur, Shahjahanpur, Aonla and Babrala. Each of the fertilizer plants has a capacity of producing 1,350 tonnes of ammonia per day. The construction of this pipeline is a unique engineering feat and has been completed at an estimated cost of over ₹ 1,700 crore. The pipeline passes through 343.7 km long rocky area, 56.3 km long forest area, besides crossing 29 railway crossings and 75 big and small rivers. This is the world's largest underground pipeline and has brought about a big transformation in the economy of Gujarat, Madhya Pradesh, Rajasthan and Uttar Pradesh. It has been extended upto Delhi so that enough gas is made available to meet the growing demand of the capital city.

5. Jamnagar-Loni LPG Pipeline. This 1,269 km long pipeline has been constructed by Gas Authority of India Limited (GAIL) at the cost of ₹ 1,250 crore. It connects Jamnagar in Gujarat to Loni near Delhi in U.P. and passes through the states of Gujarat, Rajasthan, Haryana and U.P. This is the longest LPG pipeline of the world. It is like transporting 3.5 lakh LPG gas cylinders across 1,269 km every day and its capacity is being increased to 5.0 lakh cylinders per day. It will result in net saving of ₹ 500 crore per year by eliminating road tanker movement and lead to reduction of about 10,000 tonnes of pollutant emission per year. This is the first time that cross-country pipeline has been used to transport LPG adding to availability of supplies, safety in transportation and wider distribution. LPG is received at various points along the route for bottling in Ajmer and Jaipur (Rajasthan), Piyala (Haryana), Madanpur Khadar (Delhi) and Loni (U.P.). Phase-I of the pipeline was completed in 2001 and Phase-II was completed in 2003.

6. Kandla-Bhatinda Pipeline. This 1,331 km long pipeline has been constructed for transporting crude oil to the oil refinery at Bhatinda. It has been constructed by IOC at the estimated cost of ₹ 690 crore.

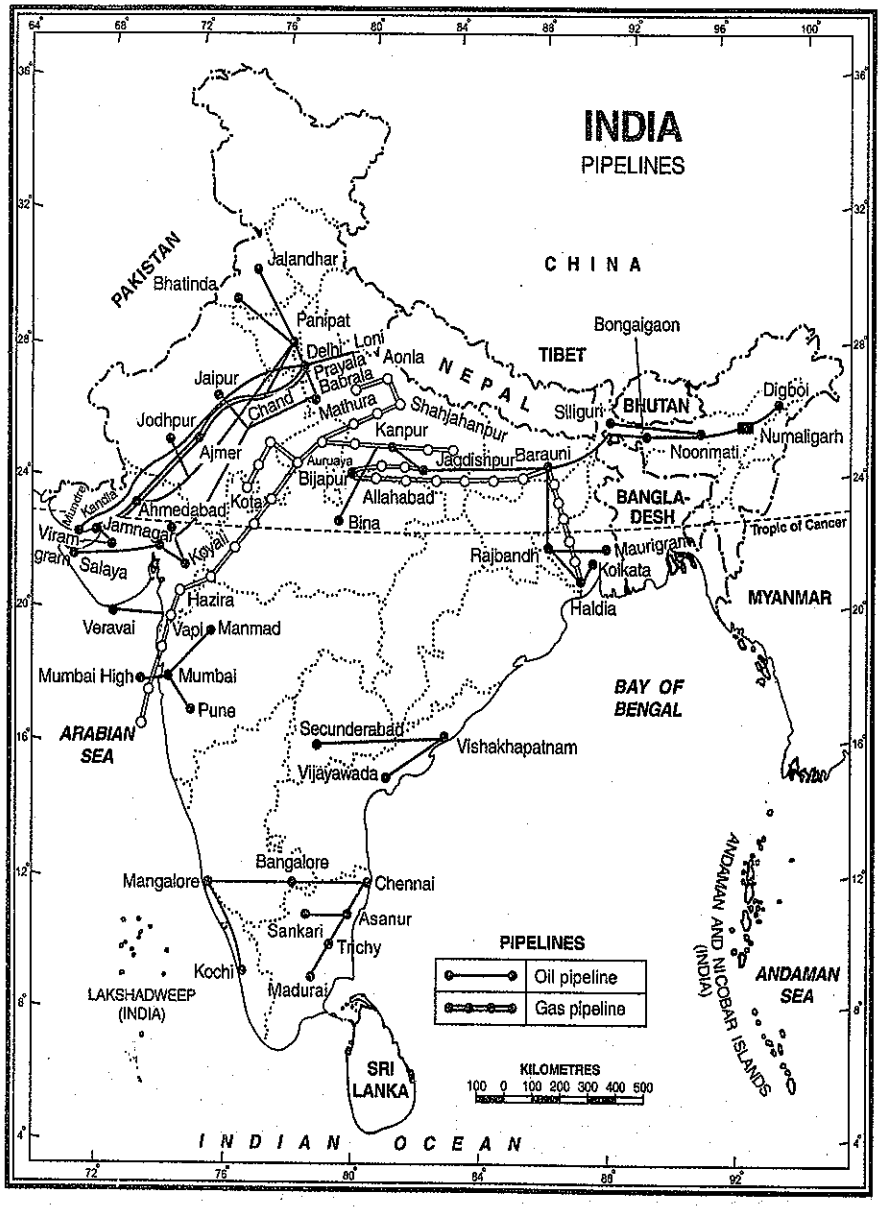

FIG. 24.7. India : Pipelines

Apart from the above mentioned important pipelines, several other pipelines have also been laid in different parts of the country. Construction of some of them has already been completed while others are at different stages of completion. In Gujarat, a number of pipelines carry crude oil, gas and refined products to refineries and markets. Important pipelines include the Kalol-Sabarmati Crude Pipeline, the Nawgam-Kalol-Koyali Crude Pipeline, the Cambay-Dhiwaran Gas Pipeline, the Ankleshwar-Uttaran Gas Pipeline, the Ankleshwar-Vadodara Associated Gas Pipeline, and the Koyali-Ahmedabad Products Pipeline. Mumbai is an important centre for petroleum products. As such, it is joined with Pune and Manmad by pipelines. The Haldia-Kolkata pipeline caters to the needs of Kolkata and its neighbouring areas.

The Gas Authority of India Ltd. (GAIL) has drawn up an ambitious plan at the cost of ₹ 10,000 crore for the "near term" which includes projects for integrating the gas pipeline network through capacity expansion and adding new pipelines. Some of the pipelines are the Dahej-Vijaipur pipeline, 300 km north-south Gujarat pipeline, Dehej-Hazira-Uran pipeline (400 km), Kochi-Mangalore-Bangalore pipeline (900 km) and Phase III of pipeline network in Andhra Pradesh. A 600 km Vishakhapatnam-Secunderabad pipeline has 1.1 million tonnes capacity. Some of the other pipelines include the Kanpur-Bina, Mangalore-Chennai, Vijayawada-Vishakhapatnam, and Haldia-Budge Budge pipelines.

GAIL has also undertaken the construction of three important gas pipelines. The 2,050 km long **Jagdishpur-Haldia** gas pipeline is the longest and the most expensive pipeline. The approximate cost of this pipeline as ₹ 7,600 crore. The **Karanpur-Moradabad-Rudrapur** pipeline is 275 km long and its cost is ₹ 250 crore. Besides there is plan to upgrade **Bajera-Agra-Ferozabad** pipeline at the cost of ₹ 200 crore. The total length of gas pipelines belonging to GAIL is 14,800 km.

There is a proposal to build a 6,000 km long gas pipeline grid on the pattern of National Highways that will criss-cross the country. It is estimated to cost over ₹ 30,000 crores.

Chennai-Trichy-Madurai oil pipeline was dedicated to the nation on 26th June, 2006. Cairn has constructed 582 km pipeline from Barmer to Salaya. It has a capacity of 1,50,000 barrels per day. **Mundra-Delhi** oil pipeline is 1,054 km long with 18 inch (about 45 cm) diameter was dedicated to the nation on February 2, 2009. Built at the cot of ₹ 1,757 crore, it carries 5 MMTPA products which is expandable to 6 MMTPA. It has main pumping station at Mundra and intermediate pumping stations at Santhalpur and Palanpur in Gujarat and Awa and Ajmer in Rajasthan. The project also includes a storage terminal at Mundra, and tap-off marketing terminals at Palanpur, Ajmer, Jaipur and Bahadurgarh.

IMPORTS

Consumption of oil and its products has always outstripped production in India. In 1950-51, India produced only 2.7 lakh tonnes of oil against consumption of 34 lakh tonnes. With the progress in industries and transport, need for oil has increased dramatically in the post-Independent era. Consequently, India has to lean heavily on the imports of oil and its products.

It is clear from Table 24.8 that our oil bill has been rising rather disturbingly both in terms of quantity and value due to our increased demands for economic growth and because of rising prices of oil and oil products in the international market. Our oil import bill increased from less than 9 per cent of the total imports in 1960s to 30 per cent following the first oil crisis in 1973-74 and to 75 per cent in 1980s after the second oil crisis. Decline in indigenous production during 1989-90 and 1993-94 further worsened the balance between production and consumption. Our imports of oil are more than three times the indigenous production. This puts serious strain on our foreign exchange reserves. With increase in growth of industries and transport, demand for oil will increase further and make things still worse. In 2011-12, our oil bill accounted for 31.7 per cent of the total imports.

TABLE 24.8. Imports of Petroleum, Oil and Lubricants

Year	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity ('000 tonnes)	800.0	1,277.0	23,537.0	29,359.0	—	—	—	—	—
Value (₹ crore)	69	136	5,264	10,816	71,497	4,82,282	7,43,075	8,91,871	10,00,064

Source : The Economic Survey 2013-14, Statistical Appendix, pp 71-73.

NATURAL GAS

Natural gas usually accompanies petroleum accumulations. Whenever a well for oil is drilled, it is natural gas which is available before oil is struck. Natural gas is fast becoming an important source of energy in India. The recoverable reserves of natural gas as on 1 April 2003 were around 700 BCM (billion cubic metre). The estimated production of natural gas was 118 million metric standard cubic metres per day in 2012-13 the major part of which came from off-shore areas. Assam, Gujarat, Andhra Pradesh and Tamil Nadu are the major on-shore producing states.

Discovery of gas made rapid strides after 1985. Oil strikes at Cauvery off-shore and at Nanda in Khambhat basin as also gas found at Talot in Jaisalmer Basin in Rajasthan were major discoveries during 1988-89. Production from South Bassein Gas Field started in September 1988. During 1989-90 oil/gas structures had been discovered in Adiyakkamanglam in Tamil Nadu, Andada in Gujarat, Khovaghat in Assam, Lingla in Andhra Pradesh, Mumbai off-shore and Kachchh offshore. Another survey conducted in 1997 in the Andamans has revealed 1,700 billion cubic feet of gas reserves which can meet the country's requirements for the next 30 years.

The face of the country's gas map has undergone a decisive change. The gas discovered by Reliance Industries in deep waters of the Krishna-Godavari off-shore basin has brought the sector into sharp focus. It is reported to be the largest discovery of natural gas in the world in the year 2002 and compares with global finding in the past in the Gulf and Sakhalin Island. The reserves are estimated to 14 trillian cubic feet. The field is 200 km into the sea from Vishakhapatnam and has blocks spread over 200,000 sq km. The wells have been drilled at depths 1350-2700 metres. This is the deepest oil exploration in India. The finding, according to a number of energy analysts, is just the tip of a 'gasberg'. However, the Krishna-Godawari basin is a very complex area because it is under the confluence of two big rivers of the peninsular India. Stratigraphy is now unraveling how sand and silt formations have taken place over the centuries. Undoubtedly the basin is rich in natural gas in its deep recesses. Hence it requires technology and expertise which goes beyond geology and geosciences and brings in engineering skill of high order. This discovery is believed to yield 60-80 million cubic metres of natural gas per day from a single field.

In June 2005, Oil and Natural Gas Corporation (ONGC) made a significant hydrocarbon find in the shallow waters of Krishna-Godawari basin, south-west of Ravva field discovered by ONGC in 1987. The new find is around 12 km from Amalpuram coast.

The above two discoveries will help in saving the precious foreign exchange and also help in transforming the economy of the Krishna-Godavari basin. The gas obtained from this basin can be used for power generation, as fuel for fertilizer plants and even for running a transport system. Since the find is equivalent to 165 million tonnes of crude oil, it will help in replacing the more polluting fuels like naphtha, fuel oil and coal.

In yet another gas discovery, the Reliance Industries struck gas off the Odisha coast in Bay of Bengal in June, 2004. Here the reserves are estimated at 4 to 5 trillion cubic feet.

In Barmer district of Rajasthan also, gas was discovered along with crude oil in 2003. It has capacity to produce 7.3 million standard cubic feet of gas per day when the production starts. Possibilities of findings gas exist in Gulf of Kachchh and Gulf of Khambhat as well as in Tripura.

About four-fifths of the total gas comes from Offshore sources. Over five per cent of the total gas of India is produced by Assam. The rest is obtained from Gujarat, Andhra Pradesh, Tamil Nadu, Tripura, and Rajasthan.

Gas is making a significant contribution towards meeting the energy requirements of the country.

Keeping in view the increasing significance of natural gas as an important source of energy, the Gas Authority of India Limited (GAIL) was incorporated in August, 1984 for transportation, processing and marketing of natural gas. The immediate task before GAIL was to complete HBJ Gas pipeline. Presently, GAIL is the largest natural gas processing, transmission and distribution company in India. It supplies gas to power plants for generation of about 5,500 MW of power, as feedstock for gas based fertilizer plants to produce about 10 million metric tonnes per annum (MMTPA) of urea. GAIL has seven plants for production of LPG with a total capacity of over one million tonnes per annum.

GAIL has taken major steps in Joint Venture companies, namely Mahanagar Gas Limited (with British Gas of U.K.) in Mumbai and Indraprastha Gas Limited (with Bharat Petroleum Corporation Limited) in Delhi for City Gas Distribution Schemes including CNG for transport sector. Besides GAIL has joint ventures with several other companies particularly in Gujarat and Kerala. On 29 November 2002, GAIL entered with a Joint Venture agreement with HPCL to distribute Piped Natural Gas, CNG and Auto LPG in cities of Andhra Pradesh.

TABLE 24.9. Production of Natural Gas in India (2011-12)

State/Region	Production in million cubic metres (mcm)	Percentage of total India production
1. Off-shore	37,826	81.21
2. Assam	2,726	5.85
3. Gujarat	2,097	4.50
4. Andhra Pradesh	1,362	2.93
5. Tamil Nadu	1,275	2.74
6. Others	1,290	2.77
Total	**46,576**	**100.00**

Source : Data computed from Mineral Wealth of India 2013.

Although India has made rapid strides in the discovery and production of natural gas, yet the production falls short of the demand which is increasing with each passing day. Gas in large quantities has to be imported to fill the widening gap between supply and demand. The Government of India has taken notable initiative in this direction. Negotiations are on with Iran and Pakistan for constructing 7,600 km long gas pipeline from Iran to India via Pakistan. This pipeline is expected to meet a major part of growing energy requirements particularly in north India. This gas pipeline will benefit all the three countries *viz.*, India, Pakistan and Iran. While India will get the much needed gas for its growing economy, Iran will find a ready market for its surplus gas in India. Pakistan also hopes to gain substantially from the economies of scale that jointly buying gas with India would provide as well as transit fee estimated to be about US $ 600 million per year for gas flowing through its territory. As such it behoves Pakistan to assure the security of this pipeline, even if that country has to depute regular army to mitigate chances of sabotage.

Sadly, required cooperation is not coming forward from Pakistan.

Conservation of Petroleum Products

India is fast becoming a big producer, consumer and importer of petroleum products. The demand for petroleum products is increasing at an alarmingly accelerated rate. At current rate of consumption, our known oil reserves will last only for 30-40 years. This puts heavy strain on our economic resources and calls for an urgent need to conserve petroleum products. There is a vast scope of petroleum conservation in India provided there are technological improvements, financial incentives, policy initiatives and legislative measures for implementing conservation. Transport, industry, domestic/household and agriculture are four major sectors which consume bulk of petroluem. Awareness programmes for each sector need to be developed and then extensive publicity of the measures which would bring about savings need to be undertaken to bring about the desired results.

The transport sector is one of the largest consumers of petroleum products mainly petrol and high speed diesel. This sector accounts for 50 per cent consumption of petroleum in India. Road transport alone accounts for about 37 per cent of the total oil consumption. With fast expanding transport network this consumption level is bound to increase. Oil products constitute nearly 80 per cent of total commercial energy used in transport (other sources being coal and electricity). Therefore, any energy conservation programme in transport sector is bound to strengthen our economy. This can be done largely by introducing more fuel efficient engines, operation of transport vehicles at optimum speed, improving road conditions and avoiding traffic bottlenecks, especially in urban areas. These measures can save about 30-35 per cent fuel. Provision of better roads alone can save 10 per cent petroleum. Extension of railway network has led to substantial savings in high speed diesel since a diesel loco is 7-8 times more

efficient compared to diesel truck. It is, therefore, logical to switch all long distance freight movement to rail and confine road transport to short distances only. Railways have initiated several measures to achieve high degree of energy conservation. The introduction of Eastern and Western Dedicated Freight Corridors is a good initiative which will increase the freight carrying capacity of the railways and save a lot of fuel. Public transport system should be strengthened so that people are not forced to use private vehicles. This can save a lot of energy.

Industries consume about 16-20 per cent of the total oil products consumed in the country. Several industries have achieved commendable success in energy conservation by better management of energy. For example, iron and steel industry, petrochemicals, cement and paper industry have saved 21, 32, 28 and 25 per cent energy respectively between 2003 and 2013. Similar steps can be taken by other industries for saving oil and other sources of energy.

In agriculture sector, the main petroleum products consumed are high speed diesel and light diesel oil. The consumption of oil in this sector can be reduced by programmes for pump rectification, more efficient foot valves for lift irrigation, better farm machinery, use of agro residues and other non-commercial sources of energy. As regards use of petroleum for production of fertilizers, plants based on liquid oil products should be discouraged and these should be based on use of natural gas or coal as feedstocks of which the country has plentiful resources.

Kerosene and LPG are two major oil products used in the domestic sector for cooking and lighting in urban and semi-urban areas. Since there are no viable alternatives to these fuels and they are to be extended to the rural areas to check deforestation, it is imperative that their utilisation is carried out at the optimum efficiency level.

The need for conservation of petroleum products has been increasingly felt during the last few years. The Petroleum Conservation Research Association (PCRA) in 1978 under the Ministry of Petroleum and Natural Gas is doing a commendable job to promote conservation of petroleum products. PCRA's activities cover conservation of all energy sources, development, evaluation and commercialization of efficient equipment and additives, popularizing petro-crop cultivation and production of bio-fuels, environment protection etc. It has been conducting public awareness campaigns for promoting energy conservation in petroleum sector on a regular basis which includes various educational and practical sessions to a variety of consumer sectors. PCRA has also launched media campaign to promote efforts of conservation and is working in close association with Bureau of Energy Efficiency (BEE) for popularizing standards and labelling programmes for equipment using petro-based fuels such as domestic LPG stoves, diesel irrigation pump sets and diesel generating sets.

ELECTRICITY

Electricity plays a dominant role in the progress and prosperity of any country. Consumption of electricity is a barometer of a nation's economic well being and standard of living of its people. Availability of abundant electricity means unrestricted growth of industries, transport and agriculture which means freedom from hunger and poverty and the resultant economic prosperity of the masses. Although India set up its first power plant over a century ago and the electrification of Kolkata began within just a decade after that of London, power development could truly take off only after Independence. The power sector registered an impressive growth by over 100 times during 63 years from 1950-51 to 2013-14. The installed capacity rose from 2.3 thousand MW in 1950-51 to 243.0 thousand MW by 2013-14 and generation from 6.6 billion kWh to 961.5 billion kWh during the same period. However, India still lags far behind regarding consumption of electricity. The per capita consumption in India was only 393 kWh in 2011-12 as against 3,481 kWh in Britain, 6,434 kWh in Sweden and 6,550 kWh in the USA and the world average of 1,000 kWh.

Following three examples illustrate that the regional distribution of installed capacity and generated power is very uneven :

(*i*) Power is more developed in regions of heavy industries where the requirement of power is very high. Mumbai industrial region and Tamil Nadu industrial belt are such examples.

TABLE 24.10. Progress of Installed Capacity of Electricity (Utilities and Non-utilities) in Thousand MW

Year	Utilities				Non-utilities	Grand Total
	Hydro	Thermal*	Nuclear	Total		
1950-51	0.6	1.1	—	1.7	0.6	2.3
1960-61	1.9	2.7	—	4.6	1.0	5.6
1970-71	6.4	7.9	0.4	14.7	1.6	16.3
1980-81	11.8	17.6	0.9	30.3	3.1	33.4
1990-91	18.8	45.8	1.5	66.1	8.6	74.7
1995-96	21.0	60.1	2.2	83.3	11.8	95.1
2005-06	32.3	88.6	3.4	124.3	21.3	145.6
2006-07	34.7	93.7	3.9	132.3	22.3	154.6
2007-08	35.9	103.0	4.1	143.0	25.0	168.0
2008-09	36.9	107.0	4.1	148.0	27.0	175.0
2009-10	36.9	118.0	4.6	159.4	31.5	190.9
2010-11	37.6	131.3	4.8	173.7	34.4	208.1
2011-12	39.0	156.1	4.8	199.9	36.5	236.4
2012-13	39.6	179.2	4.8	223.6	NA	223.6
2013-14	40.5	197.7	4.8	243.0	NA	243.0

*Including Renewable Energy Source.
NA = not available.
Source : Economic Survey 2013-14, Statistical Appendix, p. 27.

(*ii*) It is also more developed in those regions where possibilities of developing power are comparatively more. Such regions are located near coalfields (such as the Damodar valley, Singrauli coalfield etc.) or multipurpose projects like Bharkra-Nangal, Koyna etc.

(*iii*) Power is comparatively less developed in industrially backward or sparsely populated regions. Desert area of western Rajasthan, interior parts of the peninsular India, Assam and other mountainous states are examples of low level of power development.

Following types of electricity are recognised depending upon the raw material used and mode of its production.

1. Hydroelectricity.
2. Thermal Electricity (including steam, gas and oil).
3. Nuclear Electricity.

Their relative importance and temporal growth has been shown in **Table 24.10**.

HYDROELECTRICITY

The future prosperity of India depends to a great extent on our ability to produce and use hydroelectricity. The other two sources of energy, coal and petroleum, are exhaustible and will not be available to us for ever. Therefore, we should reduce our dependence on coal and petroleum and develop hydroelectricity as far as possible. Currently, hydroelectricity accounts for about 16 per cent of the total installed capacity. This has to be increased so that increasing demand for energy is met and at the same time, precious and scarce coal and petroleum resources are saved from over exploitation. Hydroelectricity is a renewable, cheap, clean and environmentally benign source of energy and will be available to us for all times to come. River water, if not properly used, will wastefully drain into the sea.

India is blessed with huge water resources and there are vast possibilities of producing hydroelectricity. However, India has developed only a small percentage of the total potential available. India's exploitable hydro-electric potential in terms of installed capacity is estimated to be about 1,48,700 MW out of which a capacity of 39.0 thousand MW (26.2%) has been developed so far. This is due to certain geographical factors as well as because of developing stage of economy. Most of the river regimes in India are extremely erratic because they are fed by monsoon rains which are highly seasonal and whimsical. Further, many rivers do not have natural waterfalls and huge capital has to be invested for constructing dams.

Most of the sites suitable for generating hydroelectricity are located away from the consuming centres as a result of which a lot of energy is wasted in transmission. Under normal circumstances, there is loss of 8 per cent energy for transmitting it through a distance of 160 km and 21 per cent loss for 800 km. Thus if hydroelectricity generated at Bhakhra Nangal dam is to be consumed at Delhi, the average loss is about 15 per cent.

The hydroelectric power generation in India made a humble start at the end of the 19th century with the commissioning of a hydroelectric power plant in 1897 to supply electricity to Darjeeling. Another hydroelectric power plant was set up at Shivasamundram waterfall on the Cauvery river in Karnataka in the year 1902. At a later stage some hydroelectric power plants were erected in the Western Ghats. These were designed to meet the growing demands of Mumbai. In 1930s, a number of hydropower plants were commissioned in Himachal Pradesh, Uttar Pradesh, Tamil Nadu and Karnataka. The total generation capacity was 508 MW at the time of independence in 1947. Planned period started immediately after independence and several multipurpose projects were undertaken during the Five Year Plans. The National Hydroelectric Power Corporation (NHPC) was set up in 1975. Till now, it has completed the construction of eight hydroelectric projects with the total installed capacity of 2,193 MW. Total installed capacity of hydroelectricity increased from 0.6 thousand MW in 1950-51 to 40.5 thousand MW in 2013-14 (**Table 24.10**). This was nearly one-fourth of the total installed capacity of electricity.

Hydroelectric power can play a significant role in view of the energy crisis which India is currently facing. Indian rivers drain 1,677 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 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 24.11**.

TABLE 24.11. 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 flowering rivers	9.0	10.7
Total	**84.0**	**100.0**

Following influence the development of Hydroelectric Power (HEP) in India :

(*i*) There should be perennial flow of large volume of water which depends upon the amount of rainfall.

(*ii*) The water should fall from a sufficient height. This height may be in the form of a natural waterfall or a fall obtained by constructing a dam across the river. It may also be obtained by diverting the water from one river basin to another.

(*iii*) A readily available market is an essential requirement for generating HEP as electricity cannot be stored.

(*iv*) The generation of HEP requires huge capital investment as it is capital intensive activity.

(*v*) It also requires technological advancement because production, distribution and utilisation are closely related to the technological level of the concerned area.

The rivers originating from the northern mountainous region and the peninsular rivers differ markedly with respect to their suitability for hydroelectric production. Some outstanding facts are explained as under :

1. Northern Rivers. These rivers are very useful for hydroelectric generation due to a large number of factors. Major factors are :

(*i*) Himalayan rivers originate from the mountainous region and have their sources in glaciers and snowfields. Therefore, they receive water both from rain in rainy season and snowmelt in hot season and have enough flow of water throughout the year. As such they are known as perennial rivers and supply water for hydroelectric production all the year round.

(*ii*) Velocity of water flow is high because of dissected terrain and steep slope. This helps in generation of hydroelectric power.

(*iii*) Low competition for use of water for other purposes makes water available for HEP production. Water used in hydroelectric generation can be gainfully used for irrigation.

(*iv*) About three-fourth of the total potential is confined to the river basins originating from the northern mountainous region. The major rivers are the Indus, the Ganga and the Brahmaputra.

2. Peninsular Rivers. The peninsular rivers are comparatively poor with respect to hydroelectric power potential and production due to following reasons :

(*i*) The peninsular rivers are purely dependent on rainfall as a result of which flow of water in these rivers is very erratic. They have exceptionally high flow during the rainy season which is followed by a prolonged dry season of lean flow. They are thus not perennial rivers and are not much suited to hydroelectric production.

TABLE 24.12. Progress of Electricity Generated (Utilities and Non-utilities) in Billion kWh

Year	Utilities				Non-tilities	Grand Total
	Hydro	Thermal*	Nuclear	Total		
1950-51	2.5	2.6	—	5.1	1.5	6.6
1960-61	7.8	9.1	—	16.9	3.2	20.1
1970-71	25.2	28.2	2.4	55.8	5.4	61.2
1980-81	56.5	61.3	3.0	120.8	8.4	129.2
1990-91	71.7	186.5	6.1	264.3	25.1	289.4
1995-96	72.6	299.3	8.0	379.9	38.2	418.0
2000-01	74.5	408.1	16.9	499.5	55.0	554.5
2005-06	101.5	506.0	17.3	623.8	73.6	697.4
2006-07	113.5	538.1	18.8	670.7	81.8	752.5
2007-08	120.4	585.3	16.9	722.6	90.5	813.1
2008.09	110.1	616.2	14.9	741.2	99.7	840.9
2009-10	104.1	677.1	18.6	799.8	106.1	906.0
2010-11	114.4	704.3	26.3	844.8	120.9	965.7
2011-12	130.5	759.4	33.3	923.2	128.2	1051.4
2012-13	113.7	760.7	32.9	907.3	NA	907.3
2013-14	134.8	792.5	34.2	961.5	NA	961.5

*Includes Renewable Energy Sources.

NA = not available

Source : Economic Survey 2013-14, Statistical Appendix, p. 28.

(*ii*) Storage of water is essential to regulate the flow.

(*iii*) The bulk of potential is confined to hilly regions.

However there are some factors which favour the development of hydroelectric power in the peninsular India.

(*i*) The topographical features in upper reaches of the major rivers are seldom favourable for development of irrigation. Consequently, development of hydroelectric sites would not clash with other priority uses of water. The Western Ghats, north-western Karnataka, Nilgiri and Anamalai hills and upper Narmada basin are major areas of concentration of potential in peninsular India.

(*ii*) Most of the areas in the southern states, especially the western part of the peninsula, are far away from the coal deposits of north-eastern part of the peninsular plateau. As such they have to depend upon the hydroelectric power to meet their energy requirements.

Generation of hydroelectricity registered a gradual increase from 2.5 billion kWh in 1950-51 to 82.9 billion kWh in 1998-99. After that juncture, downward trend started and continued till 2002-03, when the electricity generation was 64 billion kWh only. This downward trend was reversed in 2004-05 and the electricity generated increased to 134.8 billion kWh in 2013-14.

TABLE 24.13. Important Hydroelectric Plants in Different States of India

States	Name of Hydroelectric Plants
Jammu and Kashmir	Lower Jhelum, Salal on Chenab, Dool Hasti, Karrah and Banihar.
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 Bhagirathi.
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.
Odisha	Hirakud on Mahanadi, Balimela.
North-eastern 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 and Telangana	Lower Sileru, Upper Sileru, Machkund, Nizam Sagar, Nagarjun Sagar, Srisailam (Krishna).
Karnataka	Tungabhadra, Saravati, Kalinadi, Mahatma Gandhi (Jog fall), Bhadra, Sivasamudram (Kaveri), Shimasapura, Munirabad, Lungnamakki.
Kerala	Iddikki (Periyar), Sabarigiri, Kuttiaddy, Sholayar, Sengulum, Pallivasal, Kallada, Neriamangalam, Parambikulum Aliyar, Poringal, Ponniar.
Tamil Nadu	Pykara, Mettur, Kodayar, Sholayar, Aliayar, Sakarpathi, Moyar, Suruliyar, Papanasam.

Hydroelectric power plants are scattered in different parts of the country. Following **Table 24.12** gives the list of important hydroelectric power plants in different states.

Figure 24.8 shows the areal distribution of major hydel power stations in India.

Although hydroelectricity accounts for about 16 per cent of the total installed capacity of electricity in India, it is the single largest source of energy for some states. For example, Himachal Pradesh, Meghalaya, Nagaland, Sikkim and Uttarakhand wholly depend upon hydroelectricity for their energy requirements. All these states are located in hilly and mountainous areas where geographical conditions like terrain, drainage, etc. are congenial to hydroelectric generation. The other states where energy supply scene is dominated by hydroelectricity are Jammu and Kashmir, Kerala, Mizoram and Odisha. So far as total installed capacity of hydroelectricity is concerned, Andhra Pradesh (including Telangana), Karanataka, Kerala, Maharashtra, Odisha, Punjab, Rajasthan and Tamil Nadu are the outstanding states. Some of the important hydroelectric power projects are briefly discussed here.

1. Andhra Pradesh (including Telangana). Andhra Pradesh and Telangana have 3,272 MW installed capacity of hydroelectricity which is the highest capacity attained by any state in India. This capacity accounts for about 43 per cent of the total installed capacity of these two states. Nagarjun Sagar, Lower Sileru, Upper Sileru, Mechkund, Nizam Sagar, Srisailam, Inchampalli and Polavaram are the main producers.

2. Karnataka. Mahatama Gandhi Project on Jog Fall of the Sharavati river, Shivasamudram and Krishnaraja Sagar on Cauvery, Shimsha on Shishma river (a tributary of the Cauvery) are some of the outstanding power projects of Karnataka. Karnataka's installed capacity is 2,944 MW which is the second highest after Andhra's 3,272 MW. Hydroelectricity accounts for about 56.6 per cent of the total installed capacity of the state.

3. Tamil Nadu. Mettur, Pykara, Papanasam, Kadamparai, Pandiyar, Kodayar, Kundah and Periyar are the main hydroelectric producing stations in Tamil Nadu. Most of the power stations are located in hilly districts and have been connected by the electric grid system to regulate the supply of hydro power.

4. Punjab. Two power stations at Bhakhra dam on the Satluj along with Ganguwal and Kotla power projects are the main producers of hydroelectricity. Pong dam on the Beas and the Upper Bari Canal system are the other producers.

5. Uttar Pradesh. The Ganga Electric Grid System is very important for production and distribution of hydroelectricity. The Upper Ganga Canal forms 12 falls between Haridwar and Meerut and most of them have been used to produce hydroelectricity. The power stations are situated at Bahadurabad, Mohammadpur, Nirghni, Chitaura, Salwa, Bhola, Plara and Sumera. The stretch of the Upper Ganga Canal and the power stations in this area are shared by Uttarakhand and Uttar Pradesh. Matatila dam on Betwa river near Jhansi and Rihand project at Pipri in Mirzapur district are the other important producers of hydroelectricity.

6. Kerala. The state is located away from the main coal producing areas of the country and is blessed with several small but swift streams descending from the Western Ghats. Many of them form waterfalls which provide ideal sites for the generation of hydroelectricity. The state has 1,807 MW installed capacity. Idduki, Kuttiyadi, Sabargiri, Sholayar, Mananthavadi, Chalakudy, Puyankutty, Lower Periyar and Pallivasal are important projects.

7. Maharashtra. Most of the hydro-power potential is in the Sahyadris where geographical conditions are favourable for its production. Tata Hydro-electric grid at Lonavala comprises of three power houses at Khopoli (capacity 72 MW), Bivpuri (capacity 72 MW) and Bhira (capacity 137 MW). These stations supply electricity to Mumbai and its surroundings over a distance of 112 km. The Koyna project located about 240 km away from Mumbai on Koyna river (a tributary of the Krishna river) is another major landmark in Maharashtra. Purna and Vaitarna are other important projects.

8. Odisha. Over four-fifths of the total available capacity in the state is contributed by hydroelectricity.

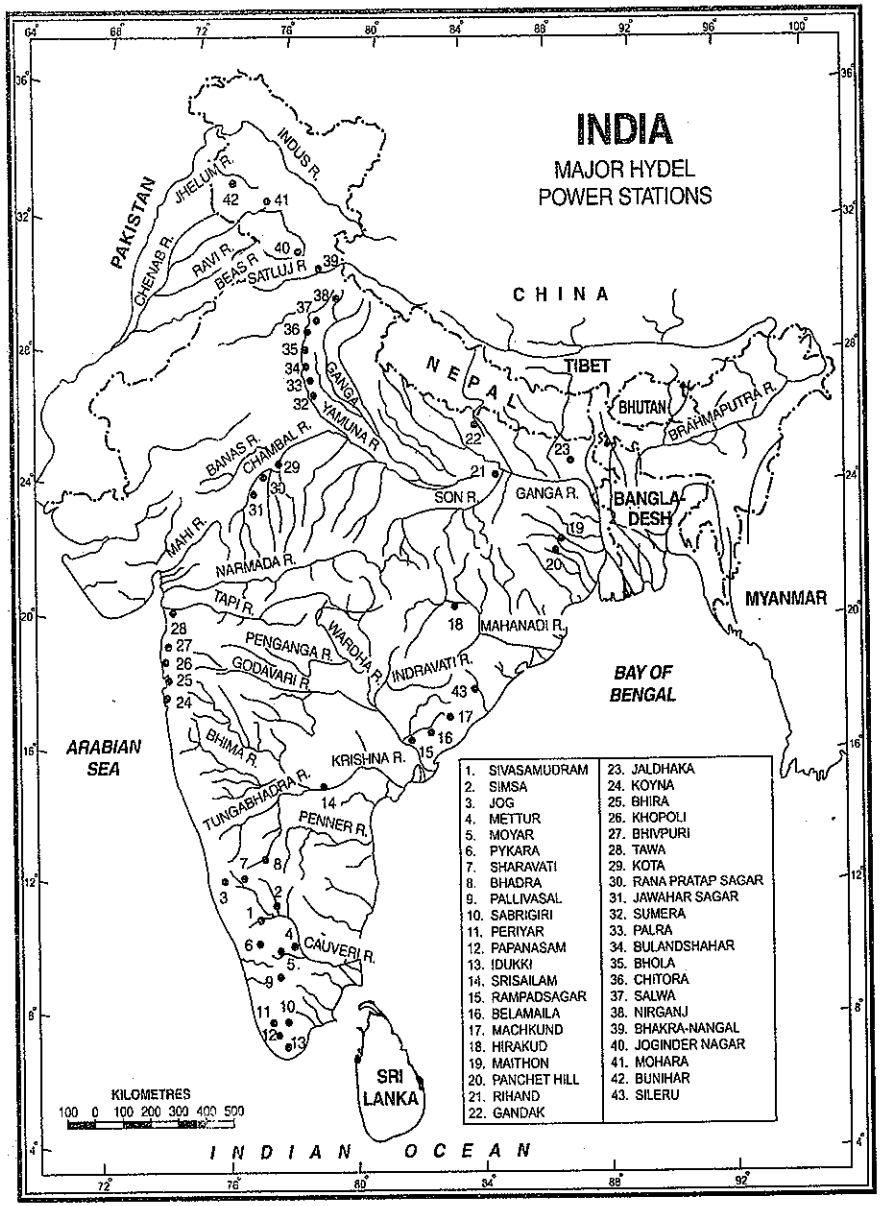

FIG. 24.8. India : Major Hydel Power Stations

Hirakud, Bhimkud, Balimela and Rengali are the main projects producing hydroelectricity.

9. Himachal Pradesh. Mandi Project at Joginder Nagar, Pandoh project on Beas river and the Shimla project produce bulk of the hydroelectricity in the state.

10. Jammu and Kashmir. The hill terrain of the state provides several suitable sites for hydroelectric generation. Chenani, Sind, Jhelum, Dool Hasti and Salal are the main producing projects.

THERMAL ELECTRICITY

This type of electricity is generated by using fossil fuels like coal, diesel and natural gas. Obviously, thermal power is influenced by the availability of these fuels.

Thermal electricity has recorded a much faster rate of growth, both with respect to installed capacity and actual generation, than its hydro and nuclear counterparts. In 1950-51 the installed capacity of thermal electricity was 1.1 thousand MW as compared to 0.6 thousand MW hydroelectricity. In 2013-14, the installed capacity of thermal electricity reached a level of 197.7 thousand MW against only 40.5 installed capacity of hydroelectricity (*see* **Table 24.10**). Thus installed capacity of thermal electricity rose by 179 times as compared to 67 times increase in hydroelectricity. Generation of hydro and thermal electricity was almost about the same level in 1950-51. But thermal power generation reached a level of 792.5 billion kWh in 2013-14 from an insignificant level of only 2.6 billion kWh in 1950-51 (*see* **Table 24.12**). The thermal power generation recorded more than 304 times increase from 1950-51 to 2013-14 whereas hydroelectricity increased from 2.5 billion kWh in 1950-51 to 134.8 billion kWh in 2013-14 (Table 24.12) thus recording only 54-fold increase during the same period. In the year 2013-14, thermal power accounted for over 82 per cent of the total power generation as compared to only 51 per cent in 1950-51.

National Thermal Power Corporation (NTPC) was established in 1975, after which the share of thermal electricity increased considerably. At present, NTPC has 13 coal-based super thermal power projects and seven gas/liquid fuel based combined cycle projects. It has an installed capacity of 19,435 MW.

Thermal electricity has special significance in those areas where geographical conditions are not very favourable for generating hydroelectricity. It accounts for more than half of the installed capacity in 14 states. In the states of Assam, Bihar, Jharkhand, Chhattisgarh, Gujarat, Mizoram and West Bengal it accounts for over 90 per cent of the installed capacity. In Madhya Pradesh, Maharashtra, Manipur and Uttar Pradesh it accounts for about three-fourths of the total installed capacity. Statewise distribution of thermal electricity is briefly described as under :

1. Maharashtra. Maharashtra is the largest producer of thermal electricity and accounts for about 16 per cent of the total thermal electricity produced in India. Chola and Trombay steam power plants, Kolhapur Diesel Turbine, Uran Gas Turbine, Chandrapur, Bhusawal, Khaparkeda, Parli, Dhobal and Ujjaini are the main thermal power producing plants.

2. Gujarat. Gujarat does not have any major river flowing through its territory which can offer suitable sites for producing hydroelectricity in appreciable measure. Therefore, 91 per cent of the installed capacity of the state comprises thermal electricity. The main plants producing thermal electricity in the state are located at Banas, Gandhinagar, Kachchh, Sabarmati, Wanakbari, Kawas, Sikka, Mahuva, Utran, Shahpur, Porbandar, Kandla, Ahmedabad, Dhuvaram, etc.

3. Andhra Pradesh. Andhra Pradesh has some coal deposits as a result of which the state has developed thermal electricity. Thermal energy account's for about 90 per cent of the total energy produced in the state. The main thermal power stations in the state are at Ramagudam, Kothagudam, Nellore, Vijayawada, Bhadrachalam, Manuguru, etc.

4. West Bengal. West Bengal has large reserves of low grade steam coal which is quite suitable for generation of thermal power. Consequently, thermal electricity comprises 97.7 per cent of the total installed capacity of the state. The major power projects of the state are Bundel, Kolkata, Durgapur, Farakka, Murshidabad, Birbhum, Kalaghat, Titagarh, Mejia, Santaldih, etc.

5. Tamil Nadu. Thermal power accounts for about 72.1% of the installed capacity of Tamil Nadu. The state produces about 5 per cent of the total thermal electricity produced in India. Neyveli, Mettur, Ennore (Chennai), etc. are important projects of Tamil Nadu.

6. Uttar Pradesh. Although Uttar Pradesh has mighty rivers flowing through its territory, the hydro-potential has not been properly harnessed. The result is that hydroelectricity forms only 6.4 per cent of the

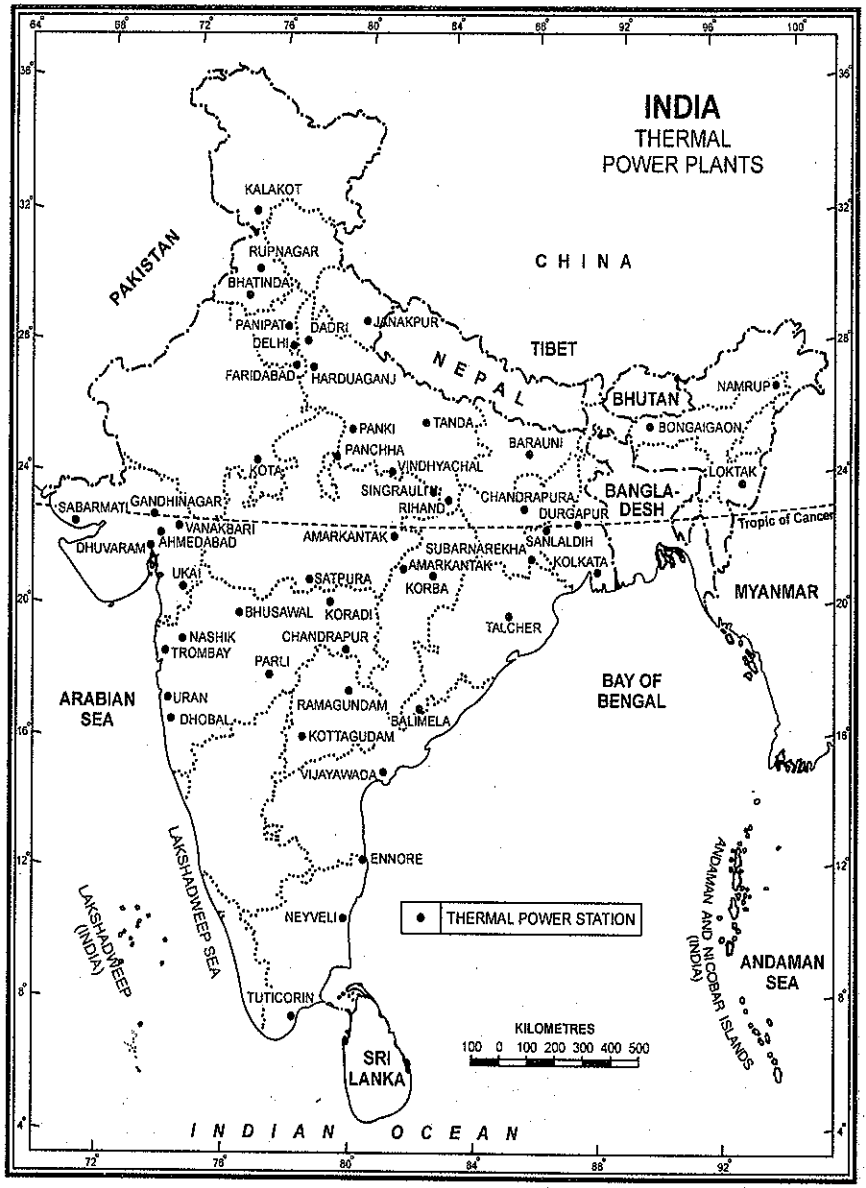

FIG. 24.9. Thermal Power Plants

total installed capacity and the remaining 93.6 per cent is constituted by thermal electricity. Most of the coal used in generating thermal electricity is brought from the neighbouring states of Jharkhand, Chhattisgarh and Madhya Pradesh. Obra (Mirzapur), Harduaganj (Aligarh), Renusagar, Rosa, Jawaharpur, Unchahar, Rihand, Kanpur, Mau (Azamgarh), Gorakhpur, Dohrighat, Moradabad, Tundla, Bahraich, etc. are important thermal power stations in Uttar Pradesh.

TABLE 24.14, Major Thermal Power Stations in India

State	Thermal Power Stations
Maharashtra	Karadi, Nashik, Kaparkheda, Paras, Bhusawal, Parli, Uran, Ballarshah, Chola, Trombay, Kolhapur, Dhobal, Ujjaini.
Gujarat	Banas, Gandhinagar, Kachchh, Sabarmati, Wanskbori, Kawas, Sikka, Mahuva, Utran, Shapur, Porbandar, Kandla, Ahmedabad, Dhuvaram, Ukai.
Andhra Pradesh	Nellore, Vijayawada, Bhadrachalam, Manuguru.
Telangana	Ramagudam, Kottagudam
West Bengal	Bundel, Kolkata, Durgapur, Farakka, Murshidabad, Birbhum, Kalaghat, Titagarh, Mejia, Santaldih, Gauripur.
Tamil Nadu	Neyveli, Methur, Ennore, Tuticorin.
Uttar Pradesh	Obra, Harduaganj, Renusgar, Rosa, Jawaharpur, Unchohar, Rihand, Kanpur, Mau, Gorakhpur, Dohrighat, Moradabad, Tundla, Bahraich
Madhya Pradesh	Singrauli, Satpura, Amarkantak.
Jharkhand	Durgapur, Subarnarekha, Chandrapura.
Chhattisgarh	Korba.
Haryana	Faridabad, Panipat, Yamunanagar.
Punjab	Bhatinda, Roopnagar.
Delhi	Indraprastha, Rajghat, Badarpur.
Rajasthan	Kota, Polana, Sawai Modhiopur, Banswara, Anta.
Assam	Namrup, Bongaigaon, Chandarpur.
Odisha	Talcher, Balimela.
Bihar	Barauni, Kahalgaon.

Other producers. Among the other producers are *Madhya Pradesh* (Singrauli, Amarkantak, Satpura), *Jharkhand* (Subarnarekha, Chadrapura), *Chhattisgarh* (Korba), *Punjab* (Bhatinda and Rupnagar), *Haryana* (Faridabad, Panipat and Yamunanagar), *Rajasthan* (Kota, Palana, Sawai Madhopur, Banswara); *Karnataka* (Raichur), *Assam* (Namrup, Bongaigaon, Chandarpur), *Odisha* (IB Valley, Talcher), and *Delhi* (Badarpur, Indraprastha, Rajghat).

Table 24.14 gives a list of major thermal power stations in India. Areal distribution of thermal power plants is shown in **Figure 24.9**.

NUCLEAR ENERGY

Nuclear energy is obtained from uranium and thorium. India has vast untapped uranium resources and there is urgent need to make use of these resources if India really wants to get out of the present scenario of power shortages and energy crisis.

Although nuclear power contributes a little over 3 per cent of our total power generation at present, it has vast potential for future development. It requires quite higher technology to develop nuclear power which India has fortunately attained now. India is one of the few countries which have developed the capability of designing, constructing, commissioning and operating a nuclear power station without any help from outside.

Most of the nuclear power stations in India have been constructed near sources of water because it is required in great quantity for cooling purposes.

Nuclear power programme was initiated in 1940s when 'Tata Atomic Research Commission' was incorporated in August, 1948. However, the real progress was made only after the establishment of the Atomic Energy Institution at Trombay in 1954. This

was renamed as the 'Bhabha Atomic Research Centre' (BARC) in 1967. The first nuclear power station with 320 MW capacity was set up at Tarapur near Mumbai in 1969. Later, atomic reactors were installed at Rawatbhata (300 MW) 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. Nuclear power plants are proposed to be set up at Kumharia (Haryana), Bargi (M.P.) Haripur (West Bengal), Jailapur (Maharashtra) Mithi Viridi (Gujarat) and Kovvada (Andhra Pradesh).

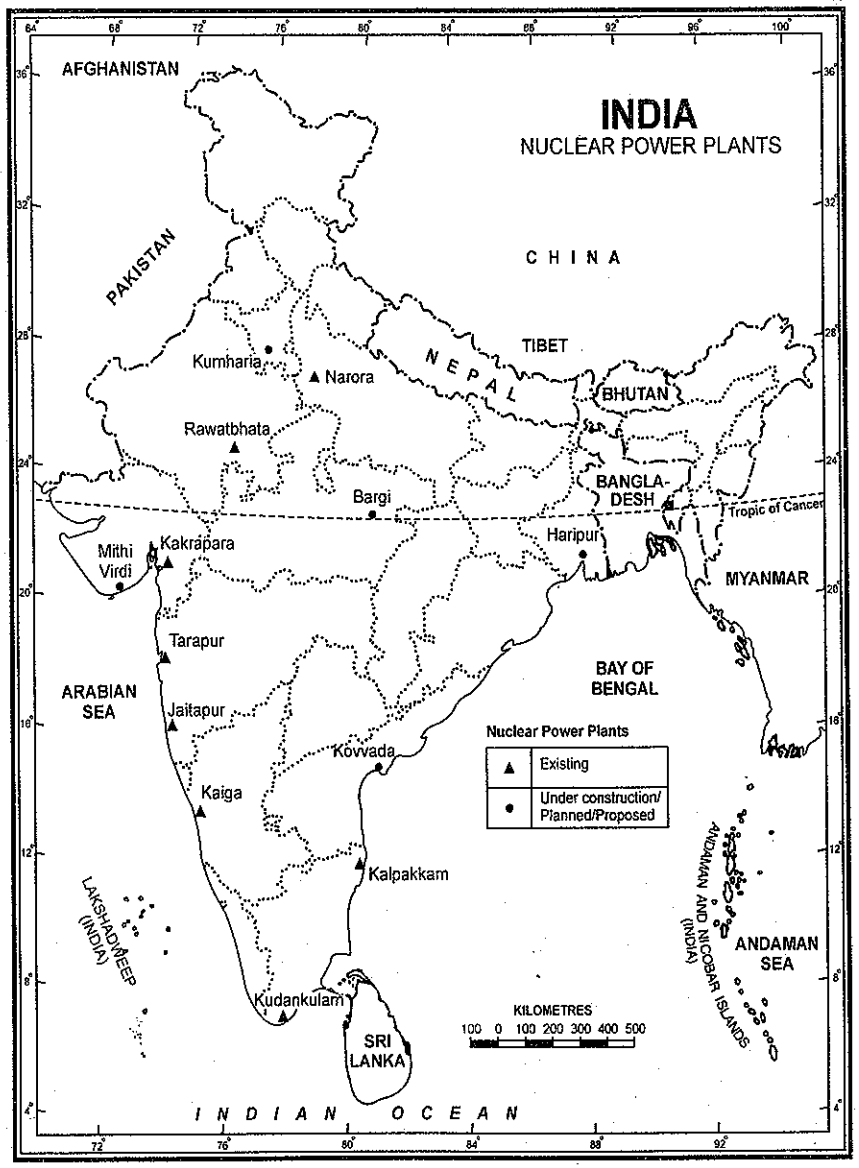

FIG. 24.10. India : Nuclear Power Plants

Nuclear Power Programme

A three stage Nuclear Power Programme was drafted by the Department of Atomic Energy (DAE) in 1954. This programme aimed at meeting the growing demand for energy in the country by utilizing natural resources of uranium and thorium. The programme involves pressurized heavy water reactors (PHWREs) in the first stage, fast breeder reactors (FBRs) in the second stage and thorium-based advanced heavy water reactors (AHWRs) in the third stage. Development of technology relating to spent-fuel reprocessing, waste management, safety and environment were also included in this programme.

Nuclear Power Programme, Stage-I. This programme was initiated in 1960s with PHWR reactor as the initial choice. It was aimed at gaining experience with two boiling water reactors (BWRs) imported from the U.S.A. installed at Tarapur Atomic Power Station (TAPs) about 110 km north of Mumbai and commissioned in 1969. In 1972, the PHWR of Candou design nuclear power plant was commissioned at Rawatbhata near Kota in Rajasthan in technical collaboration with the Atomic Energy Canada Ltd. (AECL).

The U.S.A. and Canada ceased their nuclear collaboration with India following nuclear explosion made by India at Pokran in 1974 and Indian engineers engaged themselves in developing indigenous technology. Thus the next reactor was established in 1980 after a long gap of 8 years. The indigenous technology reached its commercial maturity with the commissioning of a 2X22. PHWR at Kakarapara (Gujarat) in 1992. The state-of-the-art 2X22. PHWRs were commissioned one each at Kakarapara, Kaiga (Karnataka) and Rawatbhata (Rajasthan) in 1995, 1999 and 2000 respectively.

The Nuclear Power Corporation of India (NPCIL) a public sector undertaking of the DAE is responsible for designing, constructing and operating the nuclear power stations in India. **Table 24.15** gives details of nuclear power plants run by the NPCIL.

Nuclear fuel fabrication for nuclear reactors and research reactors is done at Nuclear Fuel Complex, Hyderabad and Bhabha Atomic Research Centre (BARC), Mumbai. The BARC and Indira Gandhi Centre for Atomic Research (ICAR) are also engaged in developing new fuels to be used in future.

TABLE 24.15. Details of nuclear power plants in India

Reactor	Type	Commercial Operation
Tarapur 1 and 2	BWR	1969
Tarapur 3 and 4	PHWR	2005-06
Kaiga 1 and 2	PHWR	1999-2000
Kaiga 3 and 4	PHWR	2007
Kakarapara 1 and 2	PMWR	1993-95
Kakarapara 3 and 4	PHWR	2012
Kalpakkam 1 and 2	PHWR	1984-86
Kalpakkam PFBR	FBR	2010
Narora 1 and 2	PHWR	1991-92
Rawatbhata 1	PHWR	1973
Rawatbhata 2	PHWR	1981
Rawatbhata 3 and 4	PHWR	1999-2000
Rawatbhata 5 and 6	PHWR	2007-08
Rawatbhata 7 and 7	PHWR	2012
Kudankulam 1 and 2	PWR	2007-08
Kudankulam 3 and 4	PWR	2012
Jaitapur 1 and 2	PWR	2012

Notes : BWR = Boiling Water Reactors.
PHWR = Pressurised Heavy Water Reactors
PWR = Pressurised Water Reactor,
FBR = Fast Breeder Reactor

Source : World Nuclear Association.

Nuclear Power Programme Stage-II. This stage envisages setting up of Fast Breeder Reactors (FBRs) heated by reprocessing plants and plutonium based fuel fabrication plants. These fast breeder systems produce more fuel than consumed by them. FBRs can increase the utilization of fuel by about 60 times than PHWRs. India is vigorously pursuing the FBRs programme to tide over the current power problem faced by the country. To manage the FBRs programme, a new PSU named Bhartiya Nabhikaiya Vidhyut Nigam (BHAVIN) was set-up in 2003.

Nuclear Power Programme, Stage-III. This stage is concerned with setting up of thorium-based reactors and associated fuel cycle facilities. Since thorium is only a fertile material, no reactor can be started using thorium directly as a fuel. Thorium is converted into uranium-233 through irradiation with neutrons in a reactor whether PHWR or FBR.

Nuclear Energy; India and the World. It has already been mentioned that only a little over 3 per cent of India's energy needs are met from nuclear sources. This is much less when compared with some of the developed and even the developing countries. For instance, France gets more than three-fourths of the energy from nuclear power and Sweden's 48% energy is received from nuclear sources (Table 24.16).

TABLE 24.16. Dependence on Nuclear Power

Country	Percentage of electricity production supplied by nuclear plants	No. of nuclear reactors
1. France	78.1	59
2. Sweden	48.2	10
3. South Korea	38.6	20
4. Hungary	37.7	4
5. Germany	31.8	17
6. Japan	30.0	55
7. U.S.A.	19.4	103
8. U.K.	18.4	19
9. Russia	15.9	31
10. Canada	15.8	18
11. Argentina	6.9	2
12. Brazil	3.3	2
13. India	3.1	17
14. Pakistan	2.7	2
15. China	1.9	10

Source : Department of Atomic Energy, International Atomic Energy Agency.

The above description brings us to the conclusion that there is vast scope for developing nuclear energy in India. However, nuclear energy development programme has to face very tough resistance from environmentalists and those who fear the occurrence of nuclear mishaps either due to natural disasters like earthquakes, tsunamis, cyclones etc. or because of human failure. Damage to Fukushima nuclear power plant in Japan caused by tsunami of March 11, 2011 is an eye opener. Several protests have been noticed against Jaitapur and Kudankulam nuclear power plants. These fears are not totally unfounded as several mishaps have taken place in different parts of the country. Some of the serious mishaps in nuclear power plants in India are detailed below.

NUCLEAR MISHAPS IN INDIA

- **May 4, 1987 (Kalpakkam).** Refueling accident damages reactor core.
- **September 10, 1989 (Tarapur).** Radioactive iodine leaks at above normal levels.
- **May 13, 1992 (Tarapur).** A malfunctioning tube causes plant to release 12 Curies of radioactivity.
- **March 31, 1993 (Narora).** Plant suffers a fire at its steam turbine blades. Shutdown lasted a year.
- **May 13, 1994 (Kaiga).** During construction, an inner containment dome meant to contain radiation collapses.
- **February 2, 1995 (Kota).** Plant leaks radioactive helium and heavy water into the Rana Pratap Sagar river.
- **Dec. 26, 2004 (Kalpakkam).** During the tsunami, sea water enters intake tunnel of plant. Plant shut down.
- **November 25, 2009 (Kaiga).** Employees fall ill. Tests show tritium content in urine of 92 employees who drank water from cooler. A disgruntled staff had poured radioactive heavy water into it.

Pattern of Electricity Consumption

Pattern of electricity consumption has undergone wide ranging changes during the last few decades. For example, the consumption of electricity in industrial sector had drastically reduced from 62.6 per cent in 1950-51 to 33.3 in 2001-02. However, a slight recovery was made in the subsequent years and the share of industrial sector in electricity consumption stood at 37.6 per cent in 2007-08 to fall again to 36.5 per cent in 2010-11. In contrast to this, consumption of electricity in agriculture had increased considerably from 3.9 per cent in 1950-51 to 31.4 in 1998-99. It appears that a stage of saturation was reached with respect to percentage of electricity consumption in agriculture in 1998-99 and downward trend has been observed afterwards. The percentage share of agricultural sector in electricity consumption came down to 20.5 in 2010-11. Consumption of electricity for domestic purposes showed varying

TABLE 24.17. Pattern of Electricity Consumption (Utilities) in per cent

Year	Domestic	Commercial	Industry	Traction	Agriculture	Others
1950-51	12.6	7.5	62.6	7.4	3.9	4.0
1960-61	10.7	6.1	69.4	3.3	6.0	4.5
1970-71	8.8	5.9	67.6	3.2	10.2	4.3
1980-81	11.2	5.7	58.4	2.7	17.6	4.4
1990-91	16.8	5.9	44.2	2.2	26.4	4.5
2000-01	23.9	7.1	34.0	2.6	26.8	5.6
2005-06	24.3	8.7	36.8	2.4	21.9	5.9
2006-07	24.4	8.8	37.6	2.4	21.9	5.1
2007-08	24.0	9.2	37.5	2.2	20.6	6.5
2008-09	24.7	10.2	37.1	2.2	20.4	5.4
2009-10	24.9	10.4	36.7	2.2	21.0	4.8
2010-11	25.2	10.4	36.5	2.2	20.5	5.4

Source : Economic Survey 2012-13, p. A-27.

trends from 1950-51 to 1980-81 after which there has been a regular rise in the percentage of electricity consumption for domestic purposes. The percentage of electricity consumption in domestic sector decreased from 12.6 in 1950-51 to 8.8 in 1970-71. It reached 11.2 per cent in 1980-81 after which it consistently rose to reach a level of 25.9 per cent in 2010-11. Percentage of electricity consumed for traction declined from 7.4 in 1950-51 to 2.2 in 2010-11 inspite of large scale electrification of railways. This is due to increased use of electricity in other fields like agriculture and domestic (see **Table 24.17**).

NON-CONVENTIONAL ENERGY SOURCES

With increasing demand for energy and with fast depleting conventional sources of energy such as coal, petroleum, natural gas, etc. the non-conventional sources of energy such as energy from sun, wind, biomass, tidal energy, geo-thermal energy and even energy from waste material are gaining importance. This energy is abundant, renewable, pollution free and eco-friendly. It can be more conveniently supplied to urban, rural and even remote areas. Thus it is capable of solving the twin problems of energy supply in a decentralised manner and helping in sustaining cleaner environment. *It is the energy of the future. No wonder, non-conventional energy is fast catching the imagination of the people in India.*

The importance of renewable energy was recognised in the country in the early 1970s. The renewable energy programme started with the establishment of the Department of Non-conventional Energy Sources (DNES) in 1982. Indian Renewable Energy Development Agency (IREDA) was set up in 1987. It was later renamed as Ministry of New and Renewable Energy (MNRE) In 1992, DNES was converted into Ministry of Non-conventional Energy Sources (MNES) which has taken several steps to create a suitable atmosphere for harnessing non-conventional sources of energy. India has today one of the largest programmes for renewable energy. The activities cover all major renewable energy sources, such as biogas, biomass, solar, wind, small hydropower and other emerging technologies. Several renewable energy systems and devices are commercially available. The renewable energy programmes cover the entire gamut of technologies, including improved wood stoves, biogas plant, biomass gasifier, solar thermal and solar photovoltaic systems, wind mill, co-generation, small hydropower, energy recovery from urban/municipal and industrial wastes, geothermal energy, hydrogen energy, electric vehicles and bio-fuels, etc. According to energy

experts, India's non-conventional energy potential is estimated at about 1,95,000 MW. An estimate of 31 per cent of this potential comes from sun, 30 per cent from ocean-thermal, 26 per cent from bio-fuel and 13 per cent from wind.

During the last two decades, several renewable energy technologies have been developed and deployed in villages and cities. Some of the achievements are given in Table 24.18 alongwith the estimated potential :

TABLE 24.18. Details of estimated renewable energy and cumulative achievements under different programmes as on 31 March, 2010

Sl. No.	Programmes/Systems	Estimated Potential	Achievement during (2010-11)	Cumulative Achievement
I.	**Power from Renewables**			
	A. Grid-Interactive renewable power			
	Biomass Power (Agro residues and Plantations)	16,881	143.50 MW	997.10 MW
	Wind Power	45,195	2,330.00 MW	14,155 MW
	Small Hydro Power (upto 25 MW)	15,000	307.21 MW	3,042.63 MW
	Cogeneration-bagasse	5,000	321.50 MW	1,667.53 MW
	Waste to Energy (Urban and Industrial)	2,700	7.50 MW	72.46 MW
	Solar Power	50 MW/sq km	26.59 MW	37.66 MW
	Total		**3,136.30 MW**	**19,972.38 MW**
	B. Off-Grid/Distributed Renewable Power including Captive/CHP Plants			
	Biomass/Cogeneration (non-Bagasse)		80.73 MW	301.61 MW
	Biomass Gasifier		10.73 MWeq	131.81 MWeq
	Energy Recovery from Wast		23.70 MWeq	70.42 Meq
	Solar PV Power Plants		4.28 MWp	8.16 MWp
	Aero-generator Hybrid Systems		177.00 kW	1.25 MW
	Total		**119.617 MWeq**	**513.25 MWeq**
II.	**Decentralized Renewable Energy Systems**			
	Family Type Biogas Plants (nos.)	120 lakh	1.51 lakh	44.04 lakh
	Solar Photovoltaic Systems			
	(*i*) Street Lighting Systems (nos.)		26,472	1,82,200
	(*ii*) Home Lighting Systems (nos.)		1,13,817	7,33,245
	(*iii*) Solar Lanterns (nos).		18,224	8,31,604
	(*iv*) Solar Photovoltaic Pumps (nos.)		106	7,334
	Solar Thermal Program			
	(*i*) Solar Water Heating Systems—			
	Collector area (m^2)	140 million	1.00 million sq m	4.47 million sq m
III.	**Remote Village Electrification**		1,537 villages and hamlets	8104 villages and hamlets
IV.	**Other Programmes**			
	Energy Parks		3 nos	514
	Aditya Solar Shops		9 nos	302

MWeq = MegaWatt equipment; MW = MegaWatt; KWp = KiloWatt Peak; sq m = Square Metre

Source : India 2012, A Reference Annual, p. 362.

In the past ten years in from 2004 to 2014, the installation of renewable energy for electricity has grown at an annual rate of 25 per cent. It has reached 30,000 MW as of January 2014. During this period, wind power installation has grown ten times and solar energy has grown from nothing to 2,500 MW. Currently renewable energy accounts for 12 per cent of total electricity generation capacity and contributes about 6 per cent of the electricity produced in the country. Renewables, therefore, produce twice the

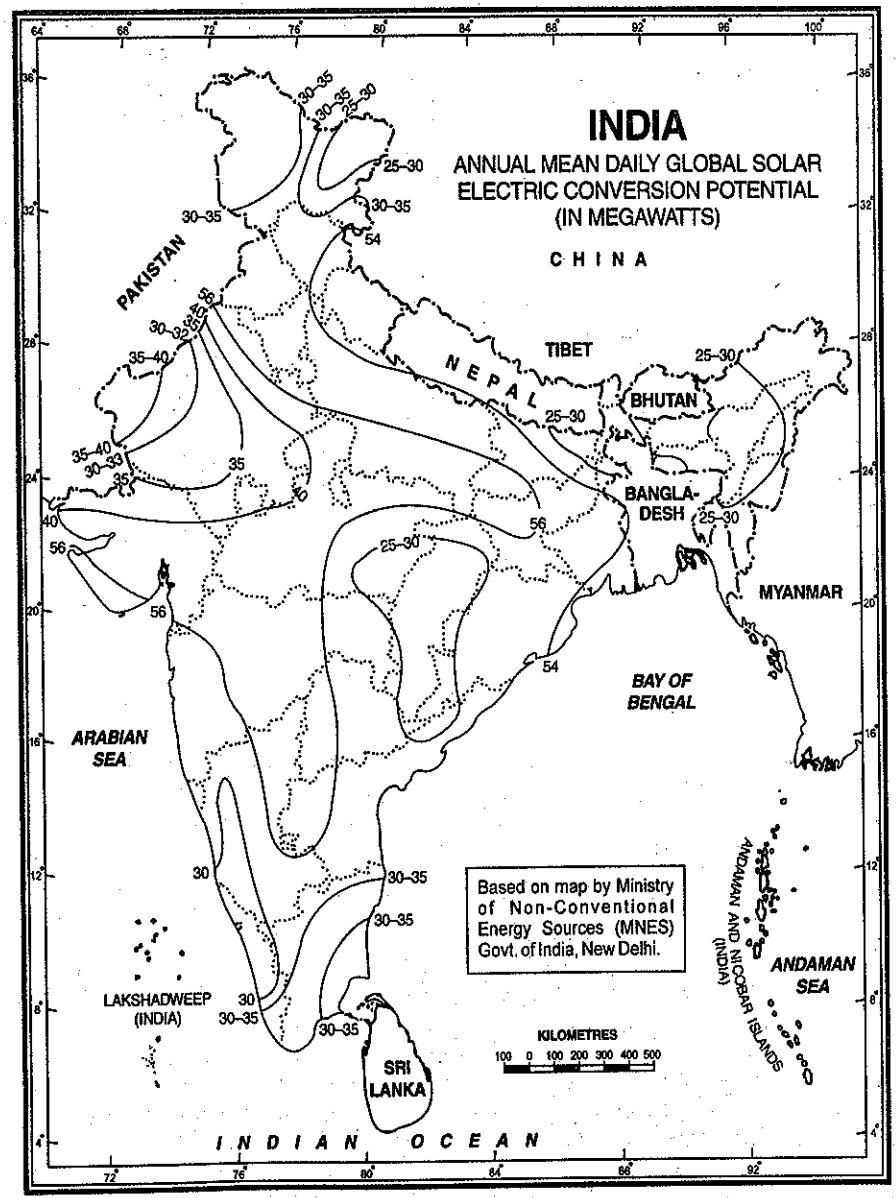

FIG. 24.11. India : Annual mean daily global solar electric conversion potential (in MW) and Solar Energy centres

amount of electricity produced in by all nuclear power plants in the country. In 2012-13 the electricity produced by renewables was equivalent to meeting per capita annual electricity requirement of above 60 million people. More than a million households in the country, today, depend solely on solar energy for their basic electricity needs (State of Renewable Energy in India, A Citizen's Report, 2014, Centre for Science and Environment).

SOLAR ENERGY

Sun is the source of all energy on the earth. India, being a tropical country, is well endowed with plenty of solar energy. Most parts of the country have bright sun-shine throughout the year except a brief monsoon period. As our country is literally soaked in sunshine, exploitation of solar energy is an extremely important component of renewable energy sector through both the thermal and photovoltaic routes for a variety of applications like cooking, water heating, drying of farm produce, water pumping, home and street lighting, power generation for meeting decentralised requirements in villages, schools, hospitals, etc. India receives nearly 3,000 hours of sunshine every year which is equivalent to over 5,000 trillion kWh per year. This is far more than the total energy consumption of the country. The daily average of solar energy incident over India varies from 4 to 7 kWh/m^2 depending upon the location. Solar water heaters, solar refrigeration, solar drying, street lighting, cooking, pumping, power generation, photovoltaic solar cells, solar ponds, etc. are becoming very popular in different parts of the country.

Although solar energy can be gainfully used in any part of the country except some higher areas in the Himalayan ranges, the Thar Desert of Rajasthan holds great promise in this direction. Scientists are of the opinion that the vast expanse of the Thar Desert could well earn the distinction of being the *biggest solar power house of the world*. The 35,000 sq km expanse of Thar Desert is sufficient to generate anything between 700 gigawatts to 2,100 gigawatts. A major chunk of the desert has been declared as 'Solar Energy Enterprise Zone' like the one in Nevada (USA). Parts of Kathiawar peninsula. Maharashtra, Karnataka, Andhra Pradesh, Telangana, Madhya Pradesh, West Bengal, Jharkhand, Bihar, Uttar Pradesh, Haryana and Punjab also hold great possibilities of harnessing solar energy. Map in Figure 24.11 shows annual mean daily global solar electric conversion potential in India.

Solar radiant energy can be used through thermal as well as photovoltaic routes. Both solar, thermal and photovoltaic applications have large potential in the country.

Solar Thermal Energy

Soaked in abundant sunshine, India offers an excellent opportunity for converting solar energy to thermal energy. Several solar thermal technologies have been developed. These include solar water heaters, solar cookers, solar heaters, solar distillation systems, etc. Research and development in the field of solar thermal energy is continuously being pursued in the country for about four decades. As a result, several products have been developed indigenously. To promote these products, a subsidy-based thermal extension programme was launched in 1984 and continued upto 1993. This initiative had resulted in disseminating the solar thermal products in different parts of the country. The main objectives of the Solar Thermal Energy Programme, being implemented by the Ministry of Non-conventional Energy Source (MNES), are market development, commercialization and utilization of solar thermal systems for the fulfilment of heat energy requirements of different applications in domestic, institutional and industrial sectors. It has five components *viz*. Solar Thermal Extension Programme, Solar Cooker Programme, Solar Buildings Programme, Research and Development (R&D) Programme and Aditya Solar Shops.

Solar Water heating is one of the main technologies being promoted by MNES. Water heating technology for low temperature range is mainly based on flat plate collectors, which absorb solar radiation and raise the temperature of water upto 80°C. This hot water can be used for various applications in homes, hotels, hostels, restaurants and hospitals. Hot water at this temperature is used in a number of industries also. Solar water systems (solar geysers) of capacities ranging from 100 to 300 litres per day are suited for domestic applications. Larger systems from hundreds to thousands of litres are used in commercial and industrial establishments.

Due to the efforts made by MNES during the last several years both the technology and the manufacturing base for solar water heating is now well established. Although the initial cost of solar water heating system is rather high, the system pays back the investment within 3 to 6 years depending on the fuels substituted. The technical potential of solar water heaters in the country has been estimated to be 140 million sq metres of collector area. There is an enormous possibility for harvesting solar energy through this technology. With the increasing acceptability in the residential sector, solar water heaters can be set up in multistoreyed residential flats for meeting the hot water requirement.

The use of solar water heaters saves electricity and contributes to a reduction in peak load demand. It has been estimated that the use of 1,000 domestic solar water heating systems of 100 litres capacity each can contribute to a peak load shaving of 1 MW.

Solar air heaters and dryers can conveniently be used both in industry and agriculture. Already a number of solar drying systems have been installed in the country and these are helping to save significant amounts of conventional fuels. Among the industries using these are tea, food processing, *dal* mills and spice manufacturers. Solar air heaters are also being used for space heating in the cold regions. Various types of collectors have been fabricated and are currently under use.

Solar cooker is a simple device which cooks food with the help of solar energy and saves conventional fuels to a significant extent. On clear sunny days, it is possible to cook both noon and evening meals with a solar cooking device. Different types of solar cookers have been developed in the past, which include box solar cooker, steam cooker, solar meal maker with heat storage and concentrating type community cooker. The Ministry of Non-Conventional Energy Sources (MNES) had been promoting the box solar cooker in the country till 1993-94 due to its various advantages over the others. Thereafter, different designs of solar cooker have been propagated under its market-oriented and demonstration programmes. Currently two types of cookers, *viz*, box solar cooker and concentration type cooker are popular among the users. *Box solar* cooker can cook meals for a family of 4 to 5 members and saves 3 to 4 LPG cylinders in a year on full use. If provided with electrical back-up, it can be used during non-sunshine hours also within the kitchen with nominal consumption of electricity. *Concentrating* type solar cooker is of three broad types, *viz*., dish solar cooker. community solar cooker and solar steam cooking system. Dish solar cooker is a fast cooking device which can cook food for 10 to 15 people under sun. It saves upto 10 LPG cylinders per year on full use in small establishments. Community solar cooker (Schefler) can cook food for around 40 people inside the kitchen and saves 35 LPG cylinders per year on full use in community kitchens. Solar steam cooking system can cook food for thousands of people using steam inside the kitchen in very short time. It is useful for installation at ashrams, temples, churches, gurudwaras, etc. A solar cooking system has been installed in Shirdi to cater to 3,000 devotees every day. World's largest system with a capacity to prepare food for 15,000 pilgrims was also set up by the Tirumala Tirupathi Devasthanam in October, 2002.

Solar cooking has been picking up fast with a number of households and institutions, especially those attracting large number of visitors, evincing interest in installing different solar cooking systems depending upon the number of persons for whom they have to prepare food everyday.

Solar Photovoltaic (SPV) technology enables direct conversion of sunlight into electricity without any moving parts and without causing pollution. Photovoltaic systems and power plants have emerged as viable power sources for applications such as lighting, water pumping and telecommunication and are being increasingly used for meeting the electrical energy needs in remote villages, hamlets and hospitals, besides households in the hilly, forest, and desert areas as well in islands. During the past few years, many organisations have started using SPV systems for a variety of applications on commercial basis as these are found to be economically viable as compared to other alternatives. Recently a programme on the deployment of SPV water pumping systems for agriculture and related uses has been implemented.

Upto 2010-11, the cumulative achievement under solar photovoltaic systems was 1,82,200 street-lighting systems, 7,33,245 home lighting systems, 8,31,604 solar lanterns and 7,334 solar photovoltaic pumps.

Efforts are being made to popularise the use of solar greenhouse for growing vegetables during off-season in cold and dry areas of Leh and Kargil. Solarised huts are being designed in cold areas of Jammu and Kashmir and Himachal Pradesh to keep the buildings warm.

Installed Capacity. Solar power has grown exponentially in India during the last few years. The country's cumulative installed capacity grew from a meager 2.12 MW in 2007-08 to 2208.36 in January 2014 (**Table 24.19**).

The Jawaharlal Nehru National Solar Missing (JNNSM) was launched on 11th January 2010 as part of National Action Plan as Climate Change to increase penetration of solar energy in India. The policy initiatives have been focussed on encouragement to set up commercial projects by providing generation based incentives for the power fed to the grid through the mechanism of renewable purchase obligation by utilities backed with preferential tariff and at the same time pursuing research and development efforts to develop indigenous technologies and capacity as well as capabilities in this sector. It aims to create and enabling policy framework for development of following solar energy applications.

Some of the states are better placed with respect to solar installed capacity than others. Maximum solar installed capacity of 860.4 MW has been reported in Gujarat, followed by Rajasthan (666.75 MW), Maharashtra (237.25 MW), Madhya Pradesh (195.32 MW) and Andhra Pradesh (92.50 MW). Tamil Nadu, Karnataka, Uttar Pradesh, Odisha, Punjab, Haryana and Chhattisgarh have less than 35 MW solar installed capacity. Other states and union territories have negligibly small solar installed capacity. Solar installed capacity of some important states is given in **table 24.21**.

Ultra Mega Solar Power Plants. On January 29, 2014, the Ministry of New and Renewable Energy (MNRE) announced the setting up of the Ultra Mega Solar Power Project in Sambhar (Rajasthan). This is the first of the four such 4,000 MW projects the MNRE plans to be installed. The other three would come up in Khargoda (Gujarat) and Ladakh and Kargil (Jammu and Kashmir). These projects are expected to cost ₹ 1.2 lakh crore (State of Renewable Energy in India, A Citizen's Report, 2014, p. 6).

TABLE 24.19. Solar installed capacity in India

Year	Installed Capacity in MW
2008-09	2.10
2009-10	9.13
2010-11	32.00
2011-12	481.48
2012-13	1446.76
January 2014	2208.36

Source : Ministry of new and renewable energy (Displayed in State of Renewable Energy in India, A Citizen's Report, Centre for Science and Environment, New Delhi 2014, p. 3)

TABLE 24.21. Solar Installed Capacity of some Important States, as on January 31, 2014

State	Solar installed capacity (MW)
1. Gujarat	860.40
2. Rajasthan	666.75
3. Maharashtra	237.25
4. Madhya Pradesh	195.32
5. Andhra Pradesh	92.90
6. Tamil Nadu	31.82
7. Karnataka	31.00

Source : Ministry of New and Renewable Energy (Displayed in State of Renewable Energy in India, A Citizen's Report (2014), p. 172.

TABLE 24.20. Jawaharlal Nehru National Solar Mission

Sr. No.	Application Segment	Phase I (2010-13)	Phase II (2013-17)	Phase III (2017-22)
1.	Solar Thermal Collectors	7 million sq meter	15 million sq metre	20 million sq metre
2.	Off Grid Solar Applications	200 MW	1,000 MW	2,000 MW
3.	Grid-Power including Roof-Top and Small Plants	1,100 MW	4,000—10,000 MW	20,000 MW

Source : India 2012, A Reference Annual, p. 352.

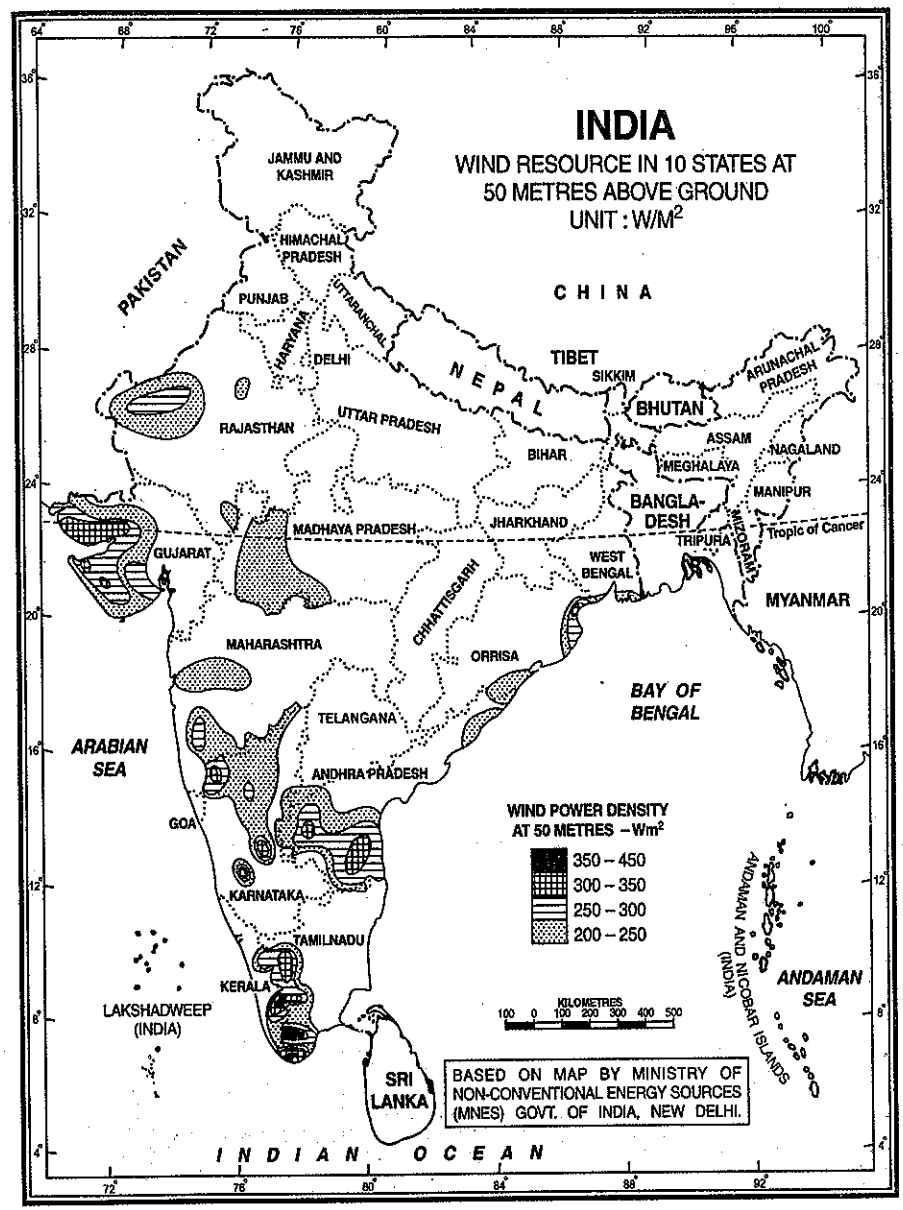

FIG. 24.12. India : Wind Resource in 10 states at 50 m above ground

WIND ENERGY

Wind is another important source of non-conventional energy. The cost inputs are only at the initial stage and the power generation starts

immediately after commissioning. Once the generation starts, cost-free power is available for about 20 years because there is no recurring cost on fuel.

India has vast wind potential and windfarms have emerged as a viable option with the advancement of wind technology in the country.

Since 1985, the MNES has carried out an extensive wind monitoring and mapping programme to identify better sites and to assess the resource potential. The programme has been implemented in a very systematic manner. The compiled data has been analysed and is being published with the ultimate objective of preparing a wind atlas of the country. This data has been utilised in identifying some excellent sites for windfarms. Map in **Figure 24.2** shows that coastal areas in Gujarat, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal as well as vast areas of Maharashtra, Madhya Pradesh and Rajasthan are in a much better position with respect to wind power resources. The map shows wind resources in 10 states as detailed data are available for these states only.

Wind Power Potential in India : Discovering more out of the thin air. Advances in turbine technology and studies exploring wind resources have opened up the immense potential of wind power in the Indian subcontinent. Centre for Wind Energy Technology (C-WET) has assessed India's wind power potential as 102,778 MW at 80 metres height considering 2 per cent land availability. This is up from the earlier estimate of approximate 49,130 MW at 50 metres with the same land availability. According to C-WET, Gujarat has the highest wind potential in the country followed by three southern coastal states, Andhra Pradesh, Tamil Nadu and Karnataka (*see* **Fig. 24.13**). Wind potential in different states).

In the past few years, other research organisations have estimated wind power potential using different models for mapping the country's wind resource. In one such study, the Lawrence Berkeley National Laboratory (LBNL), USA assumed a turbine density of 9 MW per sq km and a capacity utilisation factor of 20 per cent to estimate the country's wind potential. The study reckoned the wind potential of the country to be 2 million MW at 80 metre hub-height or 3.1 million MW at 120 metre hub-height (State of Renewable Energy in India, Citizen's Report, 2014, pp. 28, 29)

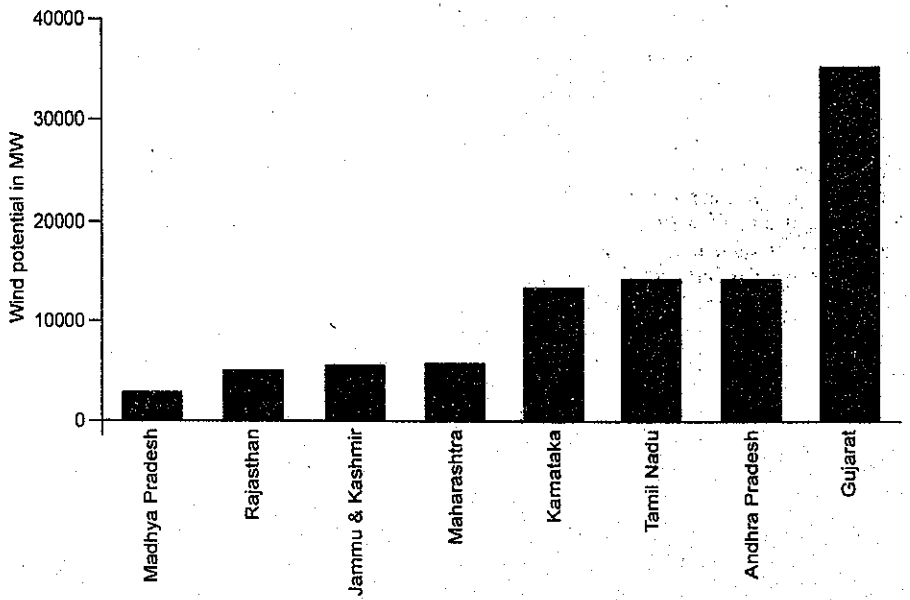

FIG. 24.13. Wind Potential in different states (upto December, 2013)

Wind Power Installation. Wind energy accounts for about 67 per cent of the total renewable energy capacity installed in India. At the end of December 2013, the total installed capacity of wind power was 20,149.5 MW. At present, India stands fifth in terms of cumulative wind power capacity after China, the U.S.A., Germany and Spain. In 2012, India accounted for about 7 per cent of the world total installed capacity. **Table 24.22** gives details of state-wise year-wise wind power installed capacity.

Growth of Wind Power : A Rollercoaster Ride. Wind power in India has grown at a cumulative annual growth rate of 26 per cent from 2002-03 to 2013-14. The installation of wind power has always

TABLE 24.22. State-wise and Year-wise Wind Power Installed Capacity (MW)

State	Upto to March 2002	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	Total
Andhra Pradesh	93.2	0	6.2	21.8	0.45	0.8	0	0	13.6	55.4	54.1	202.15	447.7
Gujarat	181.4	6.2	28.9	51.5	84.6	283.95	616.36	313.6	297.1	312.8	789.9	208.28	3074.59
Karnataka	69.3	55.6	84.9	201.5	143.8	265.95	190.3	316	145.4	254.1	206.7	201.65	2135.2
Kerala	2	0	0	0	0	0	8.5	16.5	0.8	7.4	0	0	35.2
Madhya Pradesh	23.2	0	0	6.3	11.4	16.4	130.39	25.1	16.6	46.5	100.5	9.6	385.99
Maharashtra	400.3	2	6.2	48.8	545.1	485.3	268.15	183	138.9	239.1	416.5	288.55	3,021.9
Rajasthan	16.1	44.6	117.8	106.3	73.27	111.75	68.95	199.6	350	436.7	545.7	613.95	2684.72
Tamil Nadu	877	133.6	371.2	675.5	857.55	577.9	380.67	431.1	602.2	997.4	1083.5	174.58	7162.2
Others	32	0	0	0	0	0	0	0	0	0	0	1.1	4.3
Total	1665.7	242	615.2	1111.7	1716.17	1742.05	1663.32	1484.9	1564.6	2349.2	3196.7	1699.86	19052

Source : Ministry of New and Renewable Energy, http://mnre.gov.in/file-manager/UserFiles/wp_installed.htm. (State of Renewable Energy in India, A Citizen's Report, 2014, Centre for Science and Environment, New Delhi, p. 177)

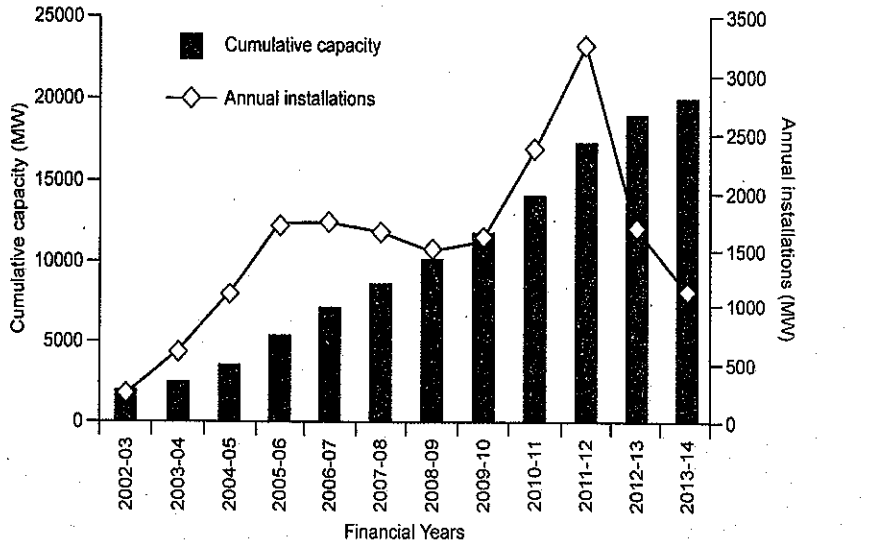

FIG. 24.14. Growth of wind power.

Source : MNRE (http://mnre.gov.in/file-manager/UserFiles/Presentations-MWM-0912014/Alok-Srivastava-JS-MNRE.pdf) (State of Renewable Energy in India, A Citizen's Report, Centre for Science and Environment, New Delhi, p. 29)

exceeded government targets. In the 10th (2002-07) and 11th (2007-12) Five-Year Plans (FYP), against targets of 1,500 MW and 9,000 MW, 5,427 MW and 10,260 MW of wind power was installed. This prompted the government to set ambitious plans for growth of wind power in the 12th FYP (2012-17). The plan set a target of 15,000 MW. However, growth was sluggish in 2012-13 and 2013-14 mainly due to withdrawal of subsidies by the government in the beginning of the 12th Five Year Plan. This has prompted MNRE to go into the mission mode. A Wind Mission has been inaugurated to develop a long-term sustainable policy framework to accelerate the wind sector's growth.

Table 24.23 shows that Tamil Nadu has recorded a maximum of 59.675 Billion kWh cumulative wind energy from 2005-06 to 2011-12. This is followed by Maharashtra, Karnataka, Gujarat, Rajasthan, Andhra Pradesh, Madhya Pradesh and Kerala.

Offshore Possibilities. India's 7,517 km long coastline offers vast wind power potential. To harness this potential, India released its offshore wind draft policy in May, 2013 which proposed an Offshore Wind Energy Steering Committee (OWSC) to frame the policy for offshore wind energy development. It also proposed formation of a National Offshore Wind Energy Authority (NOWA) to act as the nodal agency for offshore projects in the country. Although various studies have suggest immense wind energy potential along the Indian coasts, none of them has come out with concrete and reliable data. A MNRE presentation uses the study by World Institute of Sustainable Energy (WISE) to estimate Tamil Nadu's wind energy potential at 1,27,000 MW at 80 metre height. This gives us an idea of vastness of wind energy potential along our coasts. However, absorbitant cost of production will be big hindrance in the way of exploiting this huge potential. It has been estimated that the cost of offshore wind is currently ₹ 12-18 crore per MW as compared to ₹ 6 crore per MW for on-shore wind energy.

Biogas

Biogas is based upon the use of dung to produce gas which is used as domestic fuel especially in the rural areas. This technique is based on the decomposition of organic matter in the absence of air to yield gas consisting of methane (55%) and carbon dioxide (45%) which can be used as a source of energy. This energy is piped for use as cooking and lighting fuel in specially designed stoves and lamps respectively. It can also be used for replacing diesel oil in dual fuel engines for generation of motive power and electricity. The left-over digested slurry serves as an enriched manure. Biogas technology is taking deep roots in rural India because of certain inherent advantages. Biogas has higher thermal efficiency when compared with kerosene, firewood, dung and charcoal. It is observed that the thermal efficiency of gobar gas is 60 per cent while dung, which is commonly used in villages for cooking, has only 11 per cent thermal efficiency. Thus the use of gobar gas fuel is advantageous from the point of view of not only fuel efficiency but also fuel saving.

TABLE 24.23. State-wise Cumulative Wind Power Generation in Billion kWh

State	Upto 2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	Cumulative
Andhra Pradesh	0.8	0.111	0.101	0.333	0.106	0.9076	0.122	1.65
Gujarat	1.618	0.455	0.851	2.104	2.988	2.881	4.181	15.077
Karnataka	2.344	1.397	1.84	1.723	2.895	2.825	3.279	16.303
Kerala	0.047	0	0	0	0.065	0.065	0.07	0.246
Madhya Pradesh	0.33	0.07	0.069	0.003	01982	0.09	0.13	0.775
Maharashtra	3.44	1.714	1.804	2.207	2.779	2.692	3.296	17.931
Rajasthan	0.921	0.532	0.682	0.758	1.127	1.387	2.42	7.826
Tamil Nadu	15.414	5.268	6.066	6.206	8.146	8.72	9.855	59.675
Total	24.914	9.547	11.413	13.334	18.188	18.735	23.353	119.483

Source : Ministry of New and Renewable Energy, http://mnre.gov.in/file-manager/UserFiles/wp8.htm (State of Renewable Energy and India, A Citizen's Report 2014, Centre for Science and Environment, p. 177.)

Biogas technology has a bright future in India. It has been estimated that 1 to 1.5 billion tonnes of waste dung is available per annum in the country. If two-third of this quantity is used to produce biogas, it could yield 22,425 million cubic metre of biogas which could save 33,904 million litres of kerosene. Currently, it saves about 70 lakh tonnes of fuel wood annually. Further, it could yield manure equivalent to 14 million tonnes of nitrogen, 13 million tonnes of phosphate and 0.9 million tonnes of potash. The success of biogas technology has brought about a sort of *Brown Revolution* in rural India.

Although biogas plants and improved *chullahs* have been disseminated in India since 1940s, they picked up only in early 1980s. The National Project on Biogas Development (NPBD) was taken up in Central Sector during 1981-82 on country wide basis. It seeks to provide clean and convenient fuel for cooking and lighting purposes in rural areas, produce enriched organic manure, improve sanitation and hygiene by way of linking household biogas plants with toilets and reduce the drudgery of women.

Besides family size biogas plants, the Ministry of Non-conventional Energy Sources is also promoting the setting up of community, institutional and nightsoil based biogas plants. The Community and Institutional Biogas Plants (CBP/IBP) Programme was initiated in 1982-83. Under this programme, the biogas is generally used for motive power and generation of electricity, besides meeting the cooking fuel requirements. A component on biogas plants linked with community toilet complexes was added in the year 1993-94 to facilitate on site treatment of human waste. During the financial year 2010-11, 1,51,138 family type biogas plants were installed across the country, taking the cumulative installations to over 44 million biogas fertilizer plants.

National Programme on Improved Chulhas

The National Programme on Improved Chulhas (NPIC) was initiated in 1986-87 with the following objectives :

- fuel wood conservation;
- elimination/reduction of smoke;
- reduction in drudgery of women and children from cooking in smoky kitchen and collection of fuel wood;
- environmental upgradation and check on deforestation; and
- employment generation in rural areas.

Improved chullahs that do not emit smoke and use less wood, are fast replacing traditional cookstoves in rural areas ushering in what is described as *smokeless revolution* in different parts of the country. While the traditional chullahs have thermal efficiency of 8-10 per cent, the improved chullahs have minimum efficiency of 20-25 per cent. An improved chullah saves on an average about 375 kg of bio-fuel and 3 litres of kerosene per year under field conditions. Besides, an improved chullah results in a saving of 45 minutes to one hour per family which would otherwise be spent on collecting and processing the fuel material, cleaning of utensils and cooking. The improved chullah also helps in making the environment inside the kitchen smoke-free, thereby reducing the incidences of eye and lung diseases amongst women and children. The NPIC is also generating employment in rural areas for women at the rate of 0.3 person day per chullah.

A pilot project has been launched to test the efficiency and marketability of improved cook-stoves, so that the consumption of fire wood is reduced. Under the National Business Cookstoves, initiative, a pilot scale project for deployment for 5,500 biomass community cookstoves in Anganwadis, Mid-day meal scheme in schools, Tribal Hostels etc. and demonstration for 15,000 of family sized/portable cookstoves has been taken up.

The world's largest system for cooking in community kitchen has been installed at Shirdi to cook food for 20,000 people per day and is saving around 60,000 kg of LPG every year. All institutions including large institutions with hostels, hospitals/medical colleges military/paramilitary establishments, industrial organisations, academies wherever large number of meals is cooked, are the targets.

Biomass Power. Agricultural and agro-industrial residues are collectively known as biomass. Biomass gasification is a thermochemical process in which fuel gas is formed as a result of partial combustion of

biomass, such as wood waste, crop residues, agro-industrial wastes, etc. (or any organic material). The main advantage of the gasification technique is that it enables solid biomass to be converted into a more convenient and versatile fuel. The produced gas could either be burnt directly for thermal applications or be used for replacing diesel oil in dual-fuel engines for mechanical and electrical applications. Its relevance in today's world is greater than in the past as it provides an option to reduce Green House gas emissions because biomass can be CO_2 neutral in terms of emission. Gasification has vast potential for rural lighting purposes. The social and environmental benefits of biomass power for long-term sustainability have been accepted. The gasifier programme in India was launched in 1986 by the Ministry of New and Renewable Energy (MNRE) based on 3.7 kW wood based gasifiers.

MNRE reckons that over 500 million tonnes of biomass generated every year in the country has energy potential equivalent to 175 million tonnes of oil. It is also estimated that 150-200 million tonnes of biomass goes waste. This waste can generate 15,000 upto 25,000 MW of electrical power at typically prevalent plant factor load. A recent report from the Central Statistics Office estimates the potential of biomass power as 17,538 MW. MNRE also believes that more than 70,000 MW electricity can be generated from biomass grown on wastelands, road sides and on plantations along railway tracks. It has been estimated that vast stretches a wasteland would be able to produce 400 million tonnes of fuel wood per year equivalent to 60,000 MW of power. The total electricity generation potential from biomass in India had been estimated at about 1,00,000 MW. The MNRE has initiated biomass programme with a view to increase fast growing short rotation fuel wood species, suitable for plantation under the given set of agro-climatic conditions. This aims at increasing the productivity to about 40 tonnes per hectare per year as compared to the average forest tree production rate of 0.5 tonne per hectare per year. Biomass yields ranging from 12 to 37 tonnes per hectare per year have been achieved by established Biomass Research Centres.

Biomass gasifier systems of upto 500 kW capacity based on fuel-wood have been developed indigenously and are being manufactured in the country. Similarly, the technology for producing biomass briquettes from agricultural residues and forest litter at both household and industrial levels has been developed. The exploitable potential for power generation from agro residues, agro-industrial residues (excluding bagasse) and forestry residues has been estimated at 16,000 MW on a conservative basis.

Be it a small-scale unit or a remote island, the biomass gasifier has come as a saviour cutting down on the consumption of precious fossil fuels on the one hand and bringing about economic development on the other. Thanks to the initiatives and programmes of the MNES, techno-economic viability of biomass gasifiers has been demonstrated and gasifier systems for varied applications have been deployed in different parts of the country. In the process India has emerged a world leader in the development and deployment of gasifier technology and systems.

Gasifier plants have been set up in Gujarat, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, West Bengal, Nagaland and some other states. In certain areas gasifier plants have played a vital role for meeting the energy requirements of the people living in remote and inaccessible areas. It is difficult to extend grid electricity to Chhottomallakhali Island in the Sunderbans area of South 24 Parganas district of West Bengal due to prohibitive cost involved in crossing various rivers and creeks. The switching on of the 4 × 125 KW power plant based on biomass gasifier on 29th June, 2001 has completely changed the lives of inhabitants of this remote island. The plant is catering to the electricity needs of domestic, commercial and industrial users, drinking water supply, hospital, ice factory, etc.

The MNRE has planned to initiate the National Bioenergy Mission in association with state governments and other stakeholders to promote biomass related projects in the country. The mission sets targets for scaling up biomass energy in the country. Its overall target is 20,000 MW biomass projects by 2022. Satewise installed capacity and potential are given in **table 24.24**.

Cogeneration

Cogeneration is the simultaneous production of power either electrical or mechanical and useful thermal energy from a single fuel source. A cogeneration system is an integration of various components

TABLE 24.24. Biomass potential and installed capacity in India (2014)

State	Potential (MW)	Installed Capacity (MW)
1. Andhra Pradesh	578	380.75
2. Bihar	619	43.3
3. Chhattisgarh	236	219.9
4. Gujarat	1,221	30.5
5. Haryana	1,333	45.3
6. Jharkhand	90	0.0
7. Karnataka	1,131	491.38
8. Kerala	1,044	0.0
9. Maharashtra	1,887	756.9
10. Madhya Pradesh	1,364	16
11. Odisha	246	20.0
12. Punjab	3,172	124.5
13. Rajasthan	1,039	91.3
14. Tamil Nadu	1,070	538.7
15. Uttarakhand	24	10.0
16. Uttar Pradesh	1,617	776.5
17. West Bengal	396	26.0
18. Total	17,067	3,601.03

Source : Ministry of New and Renewable Energy, Data Portal of India (Displayed in State of Renewable Energy in India, A Citizen's Report (2014) Centre for Science and Environment, New Delhi, p. 182.)

(energy conversion system, balance-of-plant system, heat source, heat pump, etc.) into a total system which provides the electrical and thermal requirements of a specific industrial process.

There have been very few studies undertaken to estimate the potential for cogeneration in India. However, some surveys conducted in different industries have revealed some interesting facts. For example, nearly 30 per cent of the electricity used in the pulp and paper industry is cogenerated with steam production in paper mills. In fertilizer industry, almost all the energy requirements of the ammonia and urea plants are met with steam generated through high pressure waste heat-boilers. According to a survey of 300 industrial units, conducted by Tata Energy Research Institute (TERI) in 1993, there exists a cogeneration potential of 7,574 MW in the country (*see* **Table 24.25**) Further, TERI has estimated that cogeneration in India will increase to 61,621 MW in the year 2021.

TABLE 24.25. Cogeneration Potential Estimates by TERI

Industry	Potential	Per cent
Alumia	59	0.8
Caustic soda	394	5.2
Cement	78	1.0
Cotton textile	506	6.7
Iron & steel	362	4.8
Man-made fibre	144	1.9
Paper	594	7.8
Refineries	232	3.1
Sugar	5,131	67.7
Sulfuric Acid	74	1.0
Total	**7,574**	**100**

Source : Planning for the Indian Power Sector (1995), TERI, p. 117.

It is clear from the table that over two-thirds of the cogeneration potential is accounted for by sugar industry alone. Bagasse based cogeneration programme, launched in January 1994, envisaged creation of 300 MW power generation capacity during the Eighth Plan. According to a report from the Central Statistics Office, 5,000 MW power can be obtained from bagasse based cogneration. The Tata Energy Research Institution has estimated the cogeneration power potential based on bagasse at 5,100 MW. The programme is targeted at around 420 existing and around 90 new sugar mills. Already ten mills have commissioned co-generation projects having total exploitable power to the tune of 29 MW. This brings out the extent of untapped potential. As of January 2014, the installed capacity of bagasse base cogeneration was 2,513 MW. The potential is also significant in paper and textile industries. Considering the gains from cogeneration, the Government of India is giving several incentives for its development.

Small Hydropower

There is no globally accepted definition of a small hydropower plant (SHP) because different countries use different capacity limits for defining

SHP. For example developed countries have a range of 1.5 to 2.0 MW for defining SHP whereas in developing countries this limit varies from 25 to 50 MW. The capacity limit for SHP is 50 MW in China, 30 MW in Brazil, 20 MW in Australia and European Union, 10 MW in Norway, 5 MW in UK and only 1.5 MW in Sweden. In India, however, hydropower projects with a capacity upto 25 MW are considered as SHP. Interestingly, in India, hydropower plants with a capacity of less than 25 MW are considered renewable power source; there is no justification available why hydropower plants with more than 25 MW are not considered renewable.

Generation of electricity from small sized hydropower sources is a low cost, environment friendly and renewable source of energy. Small and mini hydel projects have the potential to provide energy in remote and hilly areas where extension of grid system is un-economical. Although SHPs have become very popular and an important source of hydropower in India, this is one of the oldest form of harnessing power in the country. The first SHP of 130 KW was installed at Darjeeling in 1897. This was followed by SHP of 2 MW at Mysore in 1902, 3 MW plant at Mussoorie in 1907 and 1.75 MW plant at Chaba and 50 MW plant at Jubbal (Near Shima) in 1930. Some of the plants are still working and contributing to hydropower generation of the country.

MNRE has estimated the potential of SHP at about 19,750 MW in 6474 sites spread all over the country. Arunachal Pradesh, Chhattisgarh, Himachal Pradesh, Jammu and Kashmir, Karnataka and Uttarakhand have maximum potential. As of January 2014, the installed capacity of SHP was 3474.15 MW and the projects of another 1076 MW were under different stages of implementation (**Fig. 24.15**).

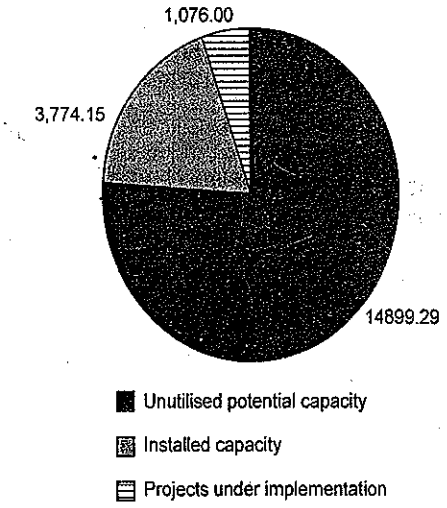

FIG. 24.15. India : Small Hydro Plants SHPs (2014)

The total installed capacity in India increased from 1,905 MW in 2006 to 3,456 MW in 2012. Similarly, the number of projects increased from 573 in 2006 to 939 in 2012 (**Fig. 24.16**).

A brief description of state-wise potential and installed capacity is given below.

Himachal Pradesh. This state has a potential of 2,398 MW in 531 sites. However, only a quarter has been utilised till March 2013.

Karnataka. Karnataka has the highest untapped potential of 3,177 MW in the country. This high potential is spread over 694 sites in different parts of the state. Sixty five projects worth 201 MW are currently under implementation. Keeping in view the environmental impact of SHPs, Karnataka Renewable Energy Policy (KREP) permits these project with less

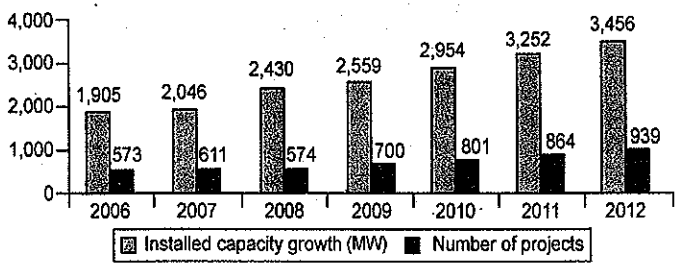

FIG. 24.16. Growth in SHP installed capacity and number of projects 2006 to 2012

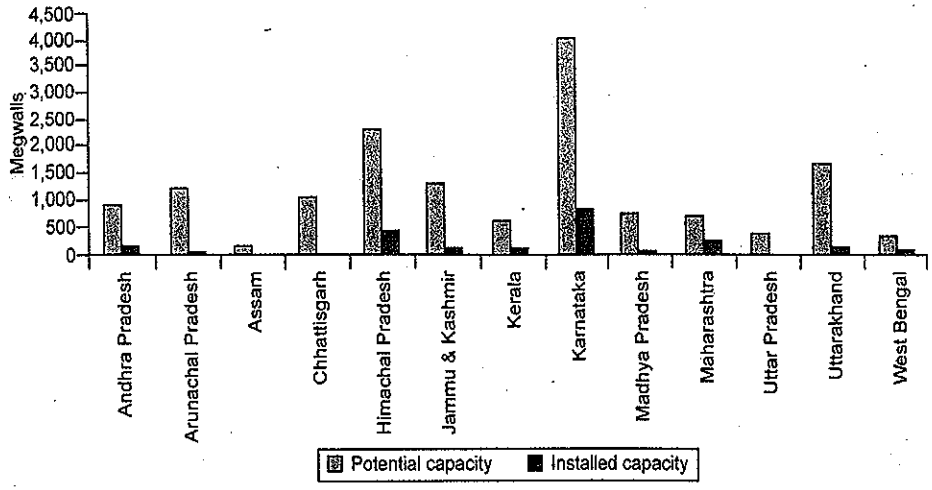

FIG. 24.17. Major states with potential and install capacity of SHP

Source : Ministry of new and renewable energy annual report 2012-13.

than 5 MW only in the Western Ghats/forest areas. KREP policy 2009-14 further says, "Mini-hydro project proposals which do not involve diversion water flow resulting in drying up the stream/river stretch will be considered for development.

Uttarakhand. This state has huge SHP untapped potential of 1,500 MW. The renewable energy policy of the state released in 2008 aimed to achieve 1,000 MW electricity form renewable sources of which 600 MW were to be achieved through SHP.

Jammu and Kashmir. This state has a potential of 1,500 MW of SHP but has developed only 150 MW. Jammu and Kashmir released a "Policy for Development of Micro/Mini-Hydro Power Projects" in 2011 which governs the establishment of SHPs.

Chhattisgarh. Chhattisgarh has an untapped potential of 1,100 MW but has an installed capacity of only 27 MW. This state has taken many steps to promote non-conventional energy in different forms.

Arunachal Pradesh. This state has 1,300 MW of SHP potential but only 100 MW has been tapped so far. Arunachal Pradesh released its SHP policy on January 24, 2008 which aimed at encouraging private operators. Projects are allocated on Build Own Operate Transfer (BOOT) basis for a period of 50 years. Till December, 2012, out of the 1,483 unelectrified villages in the state, only 425 have been electrified through SHP.

The other states with reasonable potential and SHP development are Andhra Pradesh, Assam, Kerala, Madhya Pradesh, Maharashtra, Uttar Pradesh and West Bengal (**Fig. 24.17**).

Geothermal Energy

There are vast possibilities of developing and exploiting geothermal energy in India. About 340 hot spring localities have been identified; many of them have temperature nearing boiling point. Extensive surveys are being conducted to develop geothermal energy for direct heat and power generation. Assessment of Geothermal energy potential of selected sites in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Jharkhand and Chhattisgarh has been/is being undertaken. A five kW geothermal pilot power plant has been commissioned at Manikaran in Kullu district of Himachal Pradesh. A potential of 4-5 MW geo-thermal power has been estimated in Puga Valley of Ladakh in J&K. Plan to exploit this potential has been finalised. Sanction for installation of a geothermal power plant at Tattapani geothermal fields in Chhattisgarh has been granted. A project on mushroom cultivation and poultry farming using geothermal power is under implementation at Regional Research Laboratory, Jammu.

Tidal Energy

It is estimated that India possesses 8,000-9,000 MW of tidal energy potential. The Gulf of Khambhat is the best suited area with about 7,000 MW potential of tidal energy. This is followed by Gulf of Kachchh (1,000 MW) and Sunderbans (100 MW). A 900 MW tidal power plant is proposed to be set up in the Gulf of Kachchh.

Wave Energy

Wave energy potential in India is estimated at about 40,000 MW. Coastal areas can get special benefit from this energy. One wave energy power plant of 150 kW (maximum) has been installed at Vzhinjam near Thiruvananthapuram. Another one MW wave energy plant has been set up in the Andaman and Nicobar Islands.

Ocean Thermal Energy Conversion

India's ocean thermal energy is estimated at 50,000 MW. The first ever plant for ocean thermal energy conversion with a capacity of 100 MW is proposed to be set up off the coast of Tamil Nadu.

Energy from Waste

Generation of waste is inevitable in many human activities. In nature, a balance is maintained as the waste generated by animals and human beings serve as nourishment for the plant life. So long as this natural cycle is maintained, the question of pollution due to waste does not arise. However, with increasing industrialisation, urbanisation and changes in the pattern of life, which are inevitable in any process of economic growth, waste causes damage to environment unless it is very carefully managed. According to 2011 census figures, nearly 377 million people live in urban areas and generate 110,000 – 150,000 tonnes per day (TPD) of municipal solid waste (MSW). In 2012 the Ministry of New and Renewal Energy (MNRE) estimated 4,000 MW of potential. However, not much headway has been made due to environmental issues and financial constraints. Power potential of some of the large cities generating more than one thousand tonnes per day (TPD) of MSW is given in **Table 24.26**.

Energy Crisis

India is passing through a critical phase of energy crisis as demand for energy has always outpaced its

TABLE 24.26. Energy from Waste

City	MSW generated (TPD)	Calorific Value (MJ/kg)	Power Potential (MW)
1. Greater Kolkata	11,520	5.0	129.2
2. Greater Mumbai	11,124	7.5	186.6
3. Delhi	11,040	7.5	186.8
4. Chennai	6,118	10.9	149.0
5. Greater Hyderabad	4,923	8.2	91.0
6. Greater Bengaluru	3,344	10.0	74.9
7. Pune	2,602	10.6	61.8
8. Ahmedabad	2,518	4.9	27.9
9. Kanpur	1,756	4.1	25.9
10. Surat	1,734	6.6	16.1
11. Kochi	1,366	2.5	7.6
12. Jaipur	1,362	3.5	10.7
13. Coimbatore	1,253	10.0	28.0
14. Greater Vishakhapatnam	1,194	6.7	18.0
15. Ludhiana	1,115	10.7	26.8
16. Agra	1,021	2.2	5.0

Source : R.K. Annepu, Sustainable solid waste management in India, Columbia University, New York, January, 2012.

supply. Demand for energy is increasing at an accelerated rate due to rapid increase in population, industrialization, urbanization and unprecedented increase in means of transport. Rise in living standard of the common man has further complicated the matter. The prevailing scenario of energy crisis is reflected in frequent power failures, declared and undeclared power cuts, low and fluctuating voltage and closure of power plants in different parts of the country. Most the power plants are working at below the installed capacity due to short supply of fuels like coal and gas and mismanagement of the production process. Large scale electric thefts and inefficient distribution system are other causes of energy crisis.

Peak demand, peak demand met and storage of energy are depicted in **table 24.27**. It shows that we are suffering from energy shortage varying from 11 to 15 per cent which is quite high considering our plans for rapid economic growth.

According to the Twelfth Plan projections, total domestic energy production will read 669.6 million tonne oil equivalent (MTOE) by 2016-17 and 844 MTOE by 2021-22. This will meet around 71 per cent and 69 per cent of expected energy consumption with the balance to be met from imports of oil and coal

TABLE 24.27. Power demand-supply gap (Figures in MW)

Year	Peak Demand	Peak demand met	Shortage (%)
2001	65,628	74,872	12
2002	69,189	78,441	12
2003	71,547	81,492	11
2004	75,066	84,574	12
2005	77,836	88,667	12
2006	81,370	92,968	12.5
2014	19,625	2,25,633	15.0

Source : Planning Commission.

putting heavy strain on our meager foreign exchange sources.

Our per capita energy consumption is very low at 998 kWh as compared to 1378 kWh in China, 1934 kWh in Brazil, 6231 kWh in UK, 7,816 kWh in Japan and 13,066 kWh in U.S.A. Energy crisis is likely to deepen as the per capita energy consumption will increase with the rise in living standard of the masses.

The only way out to solve the problem of energy crisis is to increase production and conserve energy.

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Manufacturing Industries

Manufacturing is the processing of primary products into more refined and usable products. Many of the natural resources cannot be utilised directly without processing. It is because of this reason that we manufacture cloth from cotton, sugar from sugarcane, paper from wood pulp, and petro-chemicals from mineral oil. By doing so, we make the primary products more valuable and usable. In other words, *manufacturing means transformation of natural material endowments into commodities of utility by processing, assembling and repairing.*

Manufacturing is vital for our very existence. It is an activity that works as an *engine of economic growth,* helps in removing poverty, and unemployment and transforms a traditional society into a modern society. The economic strength of a country is judged by the development of its industries. All the developed countries of the world are highly industrialised.

HISTORICAL PERSPECTIVE OF INDIAN INDUSTRIES

Early Times

History of Industry in India dates back to the history of mankind. India's handicrafts manufactured in village huts and houses all over the country were prized in foreign countries. Working on the locally available raw materials and with the skills and tools handed over to them by their forefathers, the village artisans produced products of high aesthetic quality with ease and efficiency. Generations of such workers provided India with a long and glorious tradition of artistic handicrafts of a varied nature. Among all the industries of early times, the textiles, especially the cotton textile industry, had the place of pride both in India and in the outside world. There is enough evidence to show that the Indians knew weaving some 1,500 years before Christ, when the Europeans were still covering themselves with animal skins. Pyrard, the 17th century Portuguese writer has recorded that every one from the Cape of Good Hope to China was clothed from head to foot in Indian made garments. The fine Dhaka muslin was the envy of the world for centuries together. Iron and Steel industry was also in advanced stage at that time. The iron column near Qutab Minar in Delhi is standing in the open and is exposed to sun, rain and weathering over 1,500 years, and it still looks fresh. It seems that this column will continue to stand there till eternity. This rare monument is a testimony to the forging and

fabricating ingenuity of ancient India. It is believed that the famous Damascus swords were made from steel imported from India. In addition to cotton textiles and steel industries; wood, stone and ivory carvings, silk textiles, pottery, bronze, brass, silver and copper works, dyeing and calico printing were also famous throughout the world.

Industrial Revolution in Europe resulted in modern factories. With this the scale of manufacturing goods increased tremendously leading to mechanisation. As a result migration of workers occurred from villages to cities. The barter system of goods with goods came to an end, exchange of goods with money started. It is correct that a revolution occurred in the manufacturing sphere but the traditional village handicrafts and cottage industries witnessed their death toll. Thousands of artisans were rendered jobless as their manufactures could not compete with the fine and low cost goods manufactured in modern industries. A near chaos prevailed in villages. Goldsmiths, blacksmiths and weavers began to starve. Thus, modern industry eroded the strong traditional industrial base.

The Rise of Modern Industry

The decline of the traditional industry and the rise of the modern industry in India were neither simultaneous nor casually connected. The beginning of modern large scale industry in India dates back to 1830 when the first charcoal fired iron making was attempted in Tamil Nadu. However, this venture collapsed in 1866. Therefore, the real beginning of the modern industry in India is recognised with the establishment of cotton textile industry at Mumbai in 1854. This industry grew tremendously in 1870s due to a spurt in demand in the wake of the American Civil War. By 1875-76, the number of cotton textile mills rose to 47. The first jute mill was set up at Rishra near Kolkata in 1855. Since the geographical conditions were very much favourable for jute industry in the Hugli basin, this industry flourished well and there were 64 mills in 1913-14, providing employment to over two lakh persons. Among the other industries which appeared on the industrial scene of India before the outbreak of World War I in 1914 were woollen textiles, paper and breweries. The main industrial centres were port cities of Mumbai, Kolkata and Chennai. This pattern of industrial location was conceived by the British rulers to facilitate imports and exports. The sole inland industrial centre of any consequence was Kanpur, the base of military equipment production.

Inter War Period. Indian industries made rapid strides during the First World War (1914-18) due to rise in demand for industrial goods by the Armed Forces. However, the real spurt was provided by the Indian Fiscal Commission set up in 1921-22. This gave the much needed protection to industries like iron and steel, textiles, cement, sugar, paper and metals. One of the most prominent feature of Indian industrial scene during this period was the dispersal of cotton textile industry away from Mumbai. In 1875-76, 61.7 per cent of cotton textile mills were located in Mumbai and by 1938-39 only 17.5% per cent of the mills remained in Mumbai. In fact this industry gained a lot as a result of war. On the eve of the war, India had emerged as the fourth largest cotton manufacturing country next to the USA, the U.K. and Japan in that order. Jute industry on the other hand, continued to concentrate in the Hugli basin only. However, the number of jute mills rose from 64 in 1913-14 to 107 in 1938-39.

World War II. While Indian industry prospered during World War I, the Second World War created problems for Indian industry. India became an active participant in war and the entry of Japan in the hostilities brought war to India's doorstep. However, the impact of war was shortlived and the industry was quick to recover from the initial shock and exploited the opportunities offered by the war. A programme costing ₹ 4 crore for the manufacture of armaments and explosives was launched in 1941 to meet the immediate requirements of war. The ordinance factories started producing 700 varieties of ammunition. There were pressing demands to meet the civilian requirements too. With this object in view, heavy chemical industry was started in 1941 and the production of sulphuric acid, synthetic ammonia, caustic soda, chlorine and bleaching powder commenced. The Hindustan Aircraft Company, also assembled its first aircraft in 1941. Metal fabricating industries such as copper were also initiated. A wide variety of engineering industries like machine tools, machinery manufacture in respect of cotton, tea, and oil processing industries, electrical equipment, vanaspati manufacturing, power, alcohol,

TABLE 25.1. Industrial Growth in India (1937 = 100)

Year	General	Cotton Textile	Jute Textile	Steel	Chemicals	Sugar	Cement	Paper
1939	105.4	104.3	90.3	108.0	84.4	88.7	124.8	121.0
1945	120.0	120.0	84.4	142.9	134.1	85.5	196.6	196.5

Source : M.R. Kulkarni, Industrial Development (2013), p. 136.

synthetic resin and plastic industries also flourished. However, some other industries including diesel engines, pumps, sewing machines and electric fans suffered a setback. By and large, the performance of individual industries varied considerably as is indicated in the **Table 25.1**.

It is clear from the table that the overall performance of industry was satisfactory. Steel, chemicals, cement and paper industries recorded impressive gains. Cotton textile industry also showed considerable improvement. However, jute and sugar industries suffered decline.

Post World War II Period and Partition. The post war period was characterised by many ups and downs and by the overall decline in industrial products. Several factors contributed to this state of affairs, the most prominent among them being fall in demand, overworked machinery, labour trouble and bottlenecks of transport and distributions till 1946. Cotton textiles, sugar, cement and steel industries were the worst sufferers. Partition of the country in 1947 threw everything out of gear and dealt a severe blow to industry in India. While Pakistan accounted for only 23 per cent of the area and 18 per cent of the population of pre-partition India, that country got 40 per cent of the cotton and 81 per cent of the jute output. Obviously, jute and cotton industries were the worst sufferers. Further India suffered losses in terms of markets as well as skilled labour that migrated to Pakistan. However, India retained most of the basic and important industries. (**Table 25.2**).

TABLE 25.2. Consequences of Partition (1947)

Item	Share in percentage	
	India	Pakistan
Area	77	23
Population	82	18
Industrial Establishments	91	9
Mineral Production	97	3
Jute output	19	81
Cotton Mills	96	4
Cotton output	60	40
Railway mileage	83	17

Source : M.R. Kulkarni, Industries Development (1998), p. 126.

The situation improved in 1948 following three year truce on labour front, tax concessions and active state help by setting up the Industrial Finance Corporation. The industrial policy of 1948 indicated the direction of industrial development in India.

Industrial Development in the Planning Era

Immediately after independence, need to take solid steps for improving industrial scene was badly felt. It was realised that industrialisation was the only vehicle which could lead the shattered economy of the country on the path of progress and prosperity. Consequently, industry attracted special attention of plans and planners.

The First Five Year Plan (1951-56). This plan became operational only four years after Independence. The main thrust of the plan was on agriculture because the country was facing shortage of foodgrains at that time. Therefore, the emphasis was on increasing capacity of existing industries rather than starting new ones. Cotton textile, sugar, vanaspati, cement, paper, chemical and engineering industries showed some progress. Some of the new industries that emerged during this plan were newsprint, power looms, medicines, paints and varnishes and transport equipment. In spite of the top priority given to agriculture, irrigation and power generation in the first five year plan, industrial production showed 40 per cent increase as compared to 30 per cent increase recorded by grain production. As a matter of fact, the First Five Year Plan laid down the basis for future progress of industries.

The Second Five Year Plan (1956-61). This plan laid emphasis on the development of basic and heavy industries and defined the key-role which the public sector was to play in the economic development of the country. A comprehensive Industrial Policy Resolution was announced on 20th April 1956. This resolution had industrial development as major thrust. Iron and steel, heavy engineering, lignite projects and fertilizer industries formed the basis of industrial planning. In addition to the expansion of pre-existing steel plants at Jamshedpur, Kulti-Burnpur and Bhadravati, three new state owned plants at Durgapur, Rourkela and Bhilai were either initiated or completed. The Chittaranjan Locomotive Workshop, The Hindustan Shipbuilding Yard (Vishakhapatnam), The Sindri Fertilizer Factory and the Hindustan Machine Tools Limited (HMT) plant at Bangalore were expanded. A heavy electrical equipment manufacturing plant was established at Bhopal. Two new fertilizer plants at Nangal and Rourkela were set up.

The Third Five Year Plan (1961-66). This plan laid stress on the expansion of basic industries like steel, chemicals, fuel, power and machine building. The basic philosophy behind this plan was to lay foundation for a 'self-generating' economy. The Hindustan Machine Tools Limited had only one factory in the Second Plan and this number rose to five in the Third Plan. Heavy Machine Tools plant at Ranchi was also completed. Machine building, locomotive and railway coach making, shipbuilding, aircraft manufacturing, chemical, drugs and fertilizers industries also made significant achievement.

However, the achievement fell short of the target to a great extent due to the following reasons :

(*i*) Untimely monsoon rains, severe drought in 1965 and bad weather conditions.

(*ii*) India's war with China in 1962 and with Pakistan in 1965.

(*iii*) Non-availability of foreign credit.

(*iv*) Inability of rigid administrative rules to cope with such abnormal situations.

The Annual Plans (1966-69)

The Fourth Five Year Plan was deferred and Annual plans were adopted for a period of three years (1966-69). Not much headway was made due to resource crunch. The index of industrial production increased only by 1.7 per cent and 0.3 per cent in 1966-67 and 1967-68 respectively. However, things improved in 1968-69 and the industrial production rose by 7 per cent.

The Fourth Five-Year Plan (1969-74). Indian Economy started recovering from recession at the beginning of the Fourth Five Year Plan. But the growth rate showed wide yearly fluctuations from peak of 7.3 per cent in 1969-70 to zero growth in 1973-74 as against the stipulated annual growth rate of 8-10 per cent. Agro-based industries such as sugar, cotton, jute, vanaspati showed uneven growth due to shortage of raw materials and difficult power situation. Metal-based industries and chemical industries also suffered setbacks. However, a significant progress was reported by some other industries like alloys and special steels, aluminium, automobile tyres, petroleum refining, electronic goods, machine tools, tractors and heavy electrical equipment. Public sector undertakings also showed good progress. Efforts were made to accentuate the process of industrial dispersal through regional and local planning process.

The Fifth Five Year Plan (1974-79). The main emphasis of this plan was on rapid growth of core sector industries and increase the production of export oriented articles and articles of mass consumption. The average annual rate of growth was 8.21 per cent. The public sector had assumed much importance. Steel plants at Salem, Vijaynagar and Vishakhapatnam were proposed to create additional capacity. Steel Authority of India (SAIL) was constituted. Drug manufacturing, oil refining, chemical fertilizers and heavy engineering industry made good progress.

The Sixth Five Year Plan (1980-85). This plan marked a watershed in the development process which was initiated three decades ago with the commencement of the first plan. Although considerable growth was achieved during the earlier five plans, much thought could not be given to quality, cost competitiveness or needs of modernisation. Thus high cost, low quality production structure had emerged. The period 1950-80 marked the first phase of industrialisation. The second phase started with the commencement of the Sixth Five Year Plan. It was

felt that large domestic and foreign market remained to be exploited for industrial growth. This was possible only if our industries were efficient, globally competitive, cost effective and modernised. For this purpose liberalisation was initiated. The average annual growth rate was 5.5 per cent which fell short of the initial target of 8 per cent.

Targets of capacity creation had been achieved for industries like aluminium, zinc, lead, thermoplastics, petro-chemicals, electrical equipment, automobiles and consumer durables. Production targets were achieved in industries like petroleum, machine tools, automobiles, T.V. receivers, etc. Shortfall in production was reported for coal, steel, cement, non-ferrous metals, drugs and pharmaceuticals, textiles, jute manufacture, commercial vehicles, railway wagons, sugar, etc.

Seventh Five Year Plan (1985-1990). This plan registered an annual growth rate of 8.5 per cent as against the target of 8.7 per cent. The plan aimed at developing a 'high tech' and electronics industrial service base. Industrial dispersal, self employment, improving the exploitation of the local resources, proper training were the main planks of the plan.

Annual Plans (1990-91 and 1991-92)

Eighth five year plan (1990-95) could not take off due to fast-changing political situation at the centre. The new Government which assumed power at the Centre in June, 1991, decided that the Eighth Five-year Plan would commence on 1 April 1992 and that 1990-91 and 1991-92 should be treated as separate Annual Plans. The impact of liberalisation was felt on industries, along with other sectors of economy.

Eighth Five Year Plan (1992-97). The major policy changes initiated in the industrial sector in 1991 included removal of entry barriers, reduction of areas reserved exclusively for public sector, rationalisation of approach towards monopolistic and restrictive practices, liberalization of foreign investment policy and import policy, removing regional imbalances and encouraging the growth of employment intensive small and tiny sector. The period immediately following the reforms was marked by low growth rates and even stagnations in the major industrial sectors. However, the growth rates quickly recovered and the index of industrial production increased by 6 per cent. The general annual growth rate in major sectors of industry was 12 per cent in 1995-96.

Ninth Five Year Plan (1997-2002). Industrial growth improved marginally to 6.6 per cent in 1997-98 but fell to 4.1 per cent in 1998-99. This decline was probably caused by poor performance in mining and manufacturing sectors. The overall industrial output grew by 6.7 per cent in 1999-2000, which again fell to 4.9 per cent in 2000-01 mainly due to fall in manufacturing sector. The growth rate of consumer goods including durables and non-durables accelerated to 7.9 per cent during 2000-01. The growth rate of basic goods, capital goods and intermediate goods declined drastically and it was estimated at 3.8 per cent, 1.4 per cent and 4.5 per cent respectively during the year 2000-01. Six core and infrastructure industries, *viz.*, electricity, crude oil, refinery, coal, steel and cement, having a weightage of 26.7 per cent in the average Index of Industrial Production (IIP) grew by 5.3 in 2000-01 compared to 9.1 per cent in 1999-2000. The main factors responsible for slowdown of industrial growth during the year 2000-01 were lack of domestic demand for immediate goods, low inventory demand for capital goods, high oil prices, existence of excess capacity in some sectors, business cycle, inherent adjustment lacks in industrial restructuring and calamity like Gujarat earthquake, and high interest rate with an adverse impact on private investment, and slow down in the world economy.

Tenth Five Year Plan (2002-07). This plan targeted a Gross Domestic Product (GDP) growth rate of eight per cent and the growth target for industrial sector had been set at ten per cent. Indian Industry, especially the manufacturing sector, was recording a consistently high growth rate which showed robustness of Indian Industry, particularly automobile/auto components and pharmaceutical sub-sectors.

For sustaining pace of growth and investment, several initiatives had been launched for modernising, technology upgradation, reducing transaction costs, increased export thrust, so as to enhance its global competitiveness and achieve balanced regional development. Further, in order to give export thrust, Department of Commerce had launched major initiatives such as Assistances to States for Infrastructure Development for Exports (ASIDE).

TABLE 25.3. Index of Industrial Production (IIP) Growth Rates (Base : 2004-05)

Group/Year	2007-08	2008-09	2009-10	2010-11	2011-12
Mining and Quarrying	4.6	2.6	7.9	5.2	–2.0
Manufacturing	18.4	2.5	4.8	8.9	3.0
Electricity	6.3	2.7	6.1	5.5	8.2
General Index	15.5	2.5	5.3	8.2	2.9
Use Based Classification					
Basic good	8.9	1.7	4.7	6.0	5.5
Capital goods	48.5	11.3	1.0	14.8	–4.0
Intermediate goods	7.3	0.0	6.0	7.4	–0.6
Consumer goods	17.6	0.9	7.7	8.5	4.4
(*i*) Consumer Durables	33.1	11.1	17	14.2	2.6
(*ii*) Consumer Non-Durables	10.2	–5.0	1.4	4.2	5.9

Source : India 2014 : A Reference Annual, p. 472.

Market Access Initiatives (MAI), Special Economic Zones (SEZs) Policy, Modernisation of Director General of Foreign Trade (DGFT), etc. For a balanced industrial development, industrial policy packages had been announced for special category states of Uttarakhand, Himachal Pradesh, Jammu and Kashmir and North East states. Social scarcity issues had been addressed through insurance cover for workers in handloom, agro and rural industrial and processed marine product sector. Textile industry is a major employment intensive sector for which special schemes/packages were introduced. Technology Upgrading Funds Scheme (TUFS) was one such scheme which was expected to improve the access for decentralized powerloom sector. Textile Center Infrastructure Development Scheme (TCIDS) was to take care of infrastructure development aspect of textile industry.

Manufacturing sector had a share of 79.36 per cent in the Index of Industrial Production (IIP). During the year 2002-03, the IIP grew at the rate of 5.8 per cent as compared to 2.1 per cent in 2001-02. Manufacturing sector registered a growth rate of 6.0 per cent as against 2.8 per cent during 2001-02. As per the use-based classification, production of basic foods, capital goods, intermediate goods and consumer goods exhibited higher increase during 2002-03 as compared to 2001-02.

Eleventh Five Year Plan (2007-12). A new series of Index of Industrial Production (IIP) with 2004-05 as its base was adopted which covered the broad sectors of industry, *viz.*, mining, manufacturing and electricity. The IIP was also categorized by Use Based Classification. **Table 25.3** shows the sectoral and use-based growth during the 11th Five Year Plan.

This table makes it clear that industrial growth measured in terms of IIP register a robust growth of 15.5 per cent in 2007-08. Thereafter, the global economic crisis led to a severe reduction in growth rate to 2.5 per cent in 2008-09. However, the industrial sector showed a quick recovery from the global showdown and registered growth rates and 5.3 per cent and 8.2 per cent respectively in 2009-10 and 2010-11. But the growth rate again fell to 2.9 in 2011-12. This decelaration of growth has been registered across almost all sectors of industry and was primarily caused by negative growth of 2.0 per cent in mining and quarrying.

Similarly use based industries also suffered a lot due to global economic crisis in 2008-09 but made some recovery in the subsequent years.

FACTORS INFLUENCING THE LOCATION OF INDUSTRIES

Many important geographical factors involved in the location of individual industries are of relative significance, *e.g.*, availability of raw materials, power resources, water, labour, markets and the transport facilities. But besides such purely geographical factors influencing industrial location, there are factors of historical, human, political and economic nature which are now tending to surpass the force of geographical advantages. Consequently, the factors influencing the location of industry can be divided into two broad categories *i.e.*

(I) Geographical factors, and
(II) Non-geographical factors.

I. Geographical Factors

Following are the important geographical factors influencing the location of industries.

1. Raw Materials. The significance of raw materials in manufacturing industry is so fundamental that it needs no emphasising. Indeed, the location of industrial enterprises is sometimes determined simply by location of the raw materials. Modern industry is so complex that a wide range of raw materials is necessary for its growth. Further we should bear in mind that finished product of one industry may well be the raw material of another. For example, pig iron, produced by smelting industry, serves as the raw material for steel making industry. Industries which use heavy and bulky raw materials in their primary stage in large quantities are usually located near the supply of the raw materials. It is true in the case of raw materials which lose weight in the process of manufacture or which cannot bear high transport cost or cannot be transported over long distances because of their perishable nature. This has been recognised since 1909 when **Alfred Weber** published his theory of location of industry. The jute mills in West Bengal, sugar mills in Uttar Pradesh, cotton textile mills in Maharashtra and Gujarat are concentrated close to the sources of raw materials for this very reason. Industries like iron and steel, which use very large quantities of coal and iron ore, losing lot of weight in the process of manufacture, are generally located near the sources of coal and iron ore.

Some of the industries, like watch and electronics industries, use very wide range of light raw materials and the attractive influence of each separate material diminishes. The result is that such industries are often located with no reference to raw materials and are sometimes referred to as *'footloose industries'* because a wide range of locations is possible within an area of sufficient population density.

2. Power. Regular supply of power is a pre-requisite for the localisation of industries. Coal, mineral oil and hydro-electricity are the three important conventional sources of power. Most of the industries tend to concentrate at the source of power. The iron and steel industry which mainly depends on large quantities of coking coal as source of power are frequently tied to coal fields. Others like the electro-metallurgical and electro-chemical industries, which are great users of cheap hydro-electric power, are generally found in the areas of hydro-power production, for instance, aluminium industry.

As petroleum can be easily piped and electricity can be transmitted over long distances by wires, it is possible to disperse the industry over a larger area. Industries moved to southern states only when hydro-power could be developed in these coal-deficient areas. Thus, more than all other factors affecting the location of large and heavy industries, quite often they are established at a point which has the best economic advantage in obtaining power and raw materials. Tata Iron and Steel Plant at Jamshedpur, the new aluminium producing units at Korba (Chhattisgarh) and Renukoot (Uttar Pradesh), the copper smelting plant at Khetri (Rajasthan) and the fertilizer factory at Nangal (Punjab) are near the sources of power and raw material deposits, although other factors have also played their role.

3. Labour. No one can deny that the prior existence of a labour force is attractive to industry unless there are strong reasons to the contrary. Labour supply is important in two respects (*a*) workers in large numbers are often required; (*b*) people with skill or technical expertise are needed. **Estall and Buchanan** showed in 1961 that labour costs can vary between 62 per cent in clothing and related industries to 29 per cent in the chemical industry; in the fabricated metal products industries they work out at 43 per cent.

In our country, modern industry still requires a large number of workers in spite of increasing mechanisation. There is no problem in securing unskilled labour by locating such industries in large urban centres. Although, the location of any industrial unit is determined after a careful balancing of all relevant factors, yet the light consumer goods and agro-based industries generally require a plentiful of labour supply.

4. Transport. Transport by land or water is necessary for the assembly of raw materials and for the marketing of the finished products. The development of railways in India, connecting the port towns with their hinterlands determined the location of many industries around Kolkata, Mumbai and Chennai. As industrial development also furthers the improvement of transport facilities, it is difficult to estimate how much a particular industry owes to original transport facilities available in a particular area.

5. Market. The entire process of manufacturing is useless until the finished goods reach the market. Nearness to market is essential for quick disposal of manufactured goods. It helps in reducing the transport cost and enables the consumer to get things at cheaper rates. It is becoming more and more true that industries are seeking locations as near as possible to their markets; it has been remarked that market attractions are now so great that a market location is being increasingly regarded as the normal one, and that a location elsewhere needs very strong justification. Ready market is most essential for perishable and heavy commodities. Sometimes, there is a considerable material increase in weight, bulk or fragility during the process of manufacture and in such cases industry tends to be market oriented.

6. Water. Water is another important requirement for industries. Many industries are established near rivers, canals and lakes, because of this reason. Iron and steel industry, textile industries and chemical industries require large quantities of water, for their proper functioning. Significance of water in industry is evident from **Table 25.4.** Also it requires 36,400 litres of water to produce one kwh of thermal electricity. Further, it is worth noting that water used in industries often gets polluted and is therefore not available for any other purpose.

TABLE 25.4. Requirement of Water in Industry

Name of the industry	Amount of water required in litres/tonne
Steel	300,000
Sulphite paper	290,000
Oil refining	25,600
Rayon	1,000,000
Paper from wood	173,000

Source : H.R. Jarrett, A Geography of Manufacturing (1977).

7. Site. Site requirements for industrial development are of considerable significance. Sites, generally, should be flat and well served by adequate transport facilities. Large areas are required to build factories. Now, there is a tendency to set up industries in rural areas because the cost of land has shot up in urban centres.

8. Climate. Climate plays an important role in the establishment of industries at a place. Harsh climate is not much suitable for the establishment of industries. There can be no industrial development in extremely hot, humid, dry or cold climate. The extreme type of climate of north-west India hinders the development of industries. In contrast to this, the moderate climate of west coastal area is quite congenial to the development of industries. Because of this reason, about 24 per cent of India's modern industries and 30 per cent of India's industrial labour is concentrated in Maharashtra-Gujarat region alone. Cotton textile industry requires humid climate because thread breaks in dry climate. Consequently, majority of cotton textile mills are concentrated in Maharashtra and Gujarat. Artificial humidifiers are used in dry areas these days, but it increases the cost of production.

II. Non-Geographical Factors

Now-a-days alternative raw materials are also being used because of modern scientific and technological developments. Availability of electric power supply over wider areas and the increasing mobility of labour have reduced the influence of geographical factors on the location of industries. The non-geographical factors are those including economic, political, historical and social factors. These factors influence our modern industries to a great extent. Following are some of the important non-geographical factors influencing the location of industries.

1. Capital. Modern industries are capital-intensive and require huge investments. Capital is usually available in urban centres. Big cities like Mumbai, Kolkata, Delhi, Chennai are big industrial centres, because the required capital is available in these cities.

2. Government Policies. Government activity in planning the future distribution of industries, for reducing regional disparities, elimination of pollution of air and water and for avoiding their heavy clustering in big cities, has become no less an important locational factor. There is an increasing trend to set up all types of industries in an area, where they derive common advantage of water and power and supply to each other the products they turn out. The latest example in our country is the establishment of a large number of industrial estates all over India even in the small-scale industrial sector.

It is of relevance to examine the influence of India's Five Year plans on industrial location in the country. The emergence of suitable industries in south India around new nuclei of public sector plants and their dispersal to backward potential areas has taken place due to Government policies.

The state policy of industrial location has a greater hand in the establishment of a number of fertiliser factories, iron and steel plants, engineering works and machine tool factories including railway, shipping, aircraft and defence installations and oil refineries in various parts in the new planning era in free India. We may conclude by noting that the traditional explanation of a location of industry at a geographically favourable point is no longer true. Location of oil refinery at Mathura, coach factory at Kapurthala and fertiliser plant at Jagdishpur are some of the results of government policies.

3. Industrial Inertia. Industries tend to develop at the place of their original establishment, though the original cause may have disappeared. This phenomenon is referred to as inertia, sometimes as *geographical inertia* and sometimes *industrial inertia*. The lock industry at Aligarh is such an example.

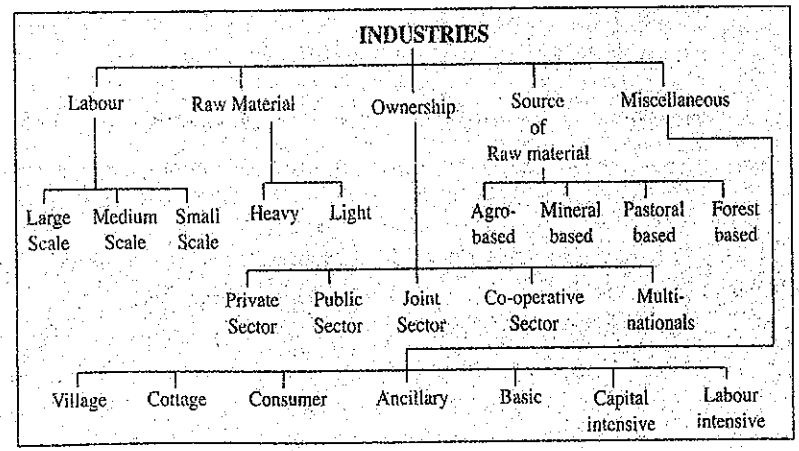
4. Efficient Organisation. Efficient and enterprising organisation and management is essential for running modern industry successfully. Bad management, sometimes squanders away the capital and puts the industry in financial trouble leading to industrial ruin. Bad management does not handle the labour force efficiently and tactfully, resulting in labour unrest. It is detrimental to the interest of the industry. Strikes and lock-outs lead to the closure of industries. Hence, there is an imperative need of effective management and organisation to run the industries.

5. Banking Facilities. Establishment of industries involves daily exchange of crores of rupees which is possible through banking facilities only. So the area with better banking facilities are better suited to the establishment of industries.

6. Insurance. There is a constant fear of damage to man, machines and materials in industries for which insurance facilities are badly needed.

CLASSIFICATION OF INDUSTRIES

Industries can be classified into several groups. The following table gives an understanding about them.



I. On the Basis of Strength of Labour

1. Large Scale Industry. Industries which employ a large number of labourers in each unit are called large-scale industries. Cotton and jute textile industries are large scale industries.

2. Medium Scale Industries. The industries which employ neither very large nor very small number of labourers are put in the category of medium scale industries. Cycle industry, radio and television industries are some examples of medium scale industries

3. Small Scale Industries. Industries which are owned and run by individuals and which employ a small number of labourers are called small scale industries.

II. On the Basis of Raw-Material and Finished Goods

Industries classified on the basis of raw materials and finished goods are :

1. Heavy Industries. Industries which use heavy and bulky raw-materials and produce products of the same category are called ***heavy*** industries. Iron and steel industry presents a good example of heavy industries.

2. Light Industries. The light industries use light raw-materials and produce light finished products. Electric fans, sewing machines are light industries.

III. On the basis of Ownership

Since the start of the planned development of Indian economy in 1951, industries are divided in the following four classes :

1. Private Sector Industries. Industries owned by individuals or firms such as Bajaj Auto or TISCO situated at Jamshedpur are called private sector industries.

2. Public Sector Industries. Industries owned by the State and its agencies like Bharat Heavy Electricals Ltd., or Bhilai Steel Plant or Durgapur Steel Plant are public sector industries.

3. Joint Sector Industries. Industries owned jointly by the private firms and the state or its agencies such as Gujarat Alkalies Ltd., or Oil India Ltd. fall in the group of joint sector industries.

4. Co-operative Sector Industries. Industries owned and run co-operatively by a group of people who are generally producers of raw materials of the given industry such as a sugar mill owned and run by farmers are called co-operative sector industries.

IV. On the Basis of Source of Raw Material

On the basis of source of raw materials, industries are classified as under :

1. Agro Based Industries. Agro based industries are those industries which obtain raw-material from agriculture. Cotton textile, jute textile, sugar and vegetable oil are representative industries of agro-based group of industries

2. Mineral Based Industries. The industries that receive raw materials primarily from minerals such as iron and steel, aluminium and cement industries fall in this category.

3. Pastoral-Based Industries. These industries depend upon animals for their raw material. Hides, skins, bones, horns, shoes, dairy, etc. are some of the pastoral-based industries.

4. Forest Based Industries. Paper card-board, lac, rayon, resin, tanning of leather, leave-utensils, basket industries are included in this type of industries.

V. Miscellaneous Industries

Industries are also classified into the following miscellaneous categories.

1. Village Industries. Village industries are located in villages and primarily cater to the needs of the rural people. They usually employ local machinery such as oil extraction, grain grinding and agricultural implements.

2. Cottage Industries. Industries which artisans set-up in their own houses, work with wood, cane, brass, stone, etc. are called cottage industries. Handloom, khadi and leather work at the artisans' house fall in this category.

3. Consumer Goods Industries. Consumer industries convert raw materials or primary products into commodities directly used by the people. Textiles, bakery products, sugar, etc. are some of the consumer goods industries.

4. Ancillary Industries. The industries which manufacture parts and components to be used by big industries for manufacturing heavy articles like trucks, buses, railway engines, tractors, etc. are called ancillary industries.

5. Basic Industries. Industries on which depend many other industries for their manufacturing processes are called basic industries. Iron and steel industry and power generating industry are included in this category.

6. Capital-Intensive Industries. Industries requiring huge investments are called capital-intensive industries. Iron and steel, cement and aluminium are outstanding examples of capital-intensive industries.

7. Labour-Intensive Industries. Industries which require huge labour force for running them are called labour-intensive industries. In these industries, labour is more important than capital. Shoe-making and bidi-manufacturing, etc. are included in these industries.

TEXTILE INDUSTRIES

Textile is a broad term which includes cotton, jute, wool, silk and synthetic fibre textiles. The textile sector occupies an important place in terms of employment generation. The sectors like handloom, handicrafts, powerloom, and readymade garments are specially known for their employment potential. Textile industries contribute about 12 per cent industrial production, 4 per cent to the GDP and provides employment to about 45 million persons which includes a substantial number of SC/ST and women. The contribution of the industry to the gross export earnings of the country is 11 per cent while adding only 2 to 3 per cent to the gross import bills of the country. It is the only industry which is self-reliant from raw material to the highest value added products, *viz.*, garments/made ups. Currently India is the third largest producer of cotton, second largest producer of silk, fifth largest producer of synthetic fibres and has the largest loomage and ring spindles in the world.

COTTON TEXTILE INDUSTRY

Growth and Development

India held world monopoly in the manufacturing of cotton textiles for about 3,000 years from about B.C. 1500 to A.D. 1500. In the middle ages, Indian cotton textile products were in great demand in the Eastern and European markets. The muslins of Dhaka, chintzes of Masulipatnam, calicos of Calicut, baftas of Cambay and gold-wrought cotton piece goods of Burhanpur, Surat and Vadodara acquired a worldwide celebrity by virtue of their quality and design. This industry could not survive in the face of strong competition from the modern mill industry of Britain which provided cheap and better goods as a result of Industrial Revolution in that country. Moreover, the British textile industry enjoyed political advantage at that time.

The first modern cotton textile mill was set up in 1818 at Fort Glaster near Kolkata. But this mill could not survive and had to be closed down. The first successful modern cotton textile mill was established at Mumbai in 1854 by a local Parsi entrepreneur **C.N. Dewar**. Shahpur mill in 1861 and Calico mill in 1863 at Ahmedabad were other landmarks in the development of Indian cotton textile industry. The real expansion of cotton textile industry took place in 1870's. By 1875-76 the number of mills rose to 47 of which over 60 per cent were located in Mumbai city alone. The industry continued to progress till the outbreak of the First World War in 1914. The total number of mills reached 271 providing employment to about 2.6 lakh persons. The First World War, the Swadeshi Movement and the grant of fiscal protection favoured the growth of this industry at a rapid pace. Demand for cloth during the Second World War led to further progress of the industry. Consequently, the number of mills increased from 334 in 1926 to 389 in 1939 and 417 in 1945. Production of cloth also increased from 4,012 million yards in 1939-40 to 4,726 million yards in 1945-46.

The industry suffered a serious setback in 1947 when most of the long staple cotton growing areas went to Pakistan as a result of partition. However, most of the cotton mills remained in India. Under such circumstances, India faced a severe crisis of obtaining raw cotton. The country had, therefore, to resort to large-scale imports of long staple cotton which was an extremely difficult task in view of the limited foreign exchange reserves. The only solution to this problem was to increase production of long staple cotton within the country. This goal was achieved to a great extent in the post partition era.

Present Position

At present, cotton textile industry is the largest organised modern industry of India. There has been a phenomenal growth of this industry during the last five decades. About 16 per cent of the industrial capital, 14 per cent of indutrial production and over 20 per cent of the industrial labour of the country is engaged in this industry. The total employment in this industry is well over 25 million workers. There are at present 1,719 textile mills in the country, out of which 188 mills are in public sector, 147 in cooperative sector and 1,384 in private sector. About three-fourths are spinning mills and the remaining one-fourth composite mills. Apart from the mill sector, there are several thousand small factories comprising 5 to 10 looms. Some of them have just one loom. These are based on conventional handloom in the form of cottage industry and comprise decentralised sector of this industry. **Table 25.5** shows that the contribution of decentralised sector is much more than the organised sector. It has increased rapidly from a mere 19.31 per cent in 1950-51 to 58.96 per cent in 1980-81 and made a sudden jump to 87.95 per cent in 1990-91. It gradually improved during the first half of 1990s and stood at all time peak of 95.41 per cent in 2007-08 after which slight fall in this percentage has been observed (**Table 25.5**)

Production. Cotton cloth is produced in three different sectors *viz.* 1. Mills, 2. Power-looms and 3. Handlooms.

1. ***Mills.*** The mill sector played a dominant role in cotton textile industry at the initial stage. But its importance was reduced drastically with the growth of powerlooms and handlooms. The share of mill sector in cotton cloth production came down from 80.69 per cent in 1950-51 to only 5.64 per cent in 2011-12.

2. Powerloom Sector. The decentralized powerloom sector is one of the most important segments of the textiles industry in terms of fabric production and employment generation. India had nearly 5.28 lakh powerloom units with 23.33 lakh powerlooms as in March, 2011. However, the number of modern shuttleless looms is only 1.15 lakh which accounts for only 5 per cent of the total powerlooms

TABLE 25.5. Progress of Cotton Textile Industry in India

Year	Spun yarn (by cotton textile mills) in million kg	Cotton Cloth (Million Sq. Metres)			
		Mill sector	Decentr-alised sector	Total	Percentage of decentralised sector to total
1950-51	533	3,401	814	4,215	19.31
1960-61	788	4,649	2,089	6,738	31.00
1970-71	929	4,055	3,547	7,602	46.66
1980-81	1,087	3,434	4,934	8,368	58.96
1990-91	1,510	1,859	13,572	15,431	87.95
2000-01	2,267	1,106	18,612	19,718	94.39
2005-06	2,521	1,192	22,681	23,873	95.01
2006-07	2,824	1,305	24,933	26,238	95.03
2007-08	2,948	1,249	25,947	27,196	95.41
2008-09	2,896	1,259	25,639	26,898	95.32
2009-10	3,079	1,465	27,449	28,914	94.93
2010-11	3,490	1,604	30,114	31,718	94.94
2011-12	3,126	1,724	28,846	30,570	94.36

Source : Data Computed from Economic Survey 2012-13, pp. A-32-33.

in the country. This sector of textile industry provides direct/indirect employment to 57.29 lakh persons and contributes about 62 per cent to the total cloth production. The cloth output from this sector increased from 30.63 billion square metres in 2005-056 to 37.52 billion square meter in 2010-11. This sector produces almost all varieties of cloth including technical textiles. More than 60 per cent of the fabric meant for export is also sourced from powerlooms sector. The ready-made garments and home textile sectors are heavily dependent on this sector to meet their fabric requirements. The major powerloom clusters are at Bhiwandi, Erode, Salem, Madurai, Ichalkaranji, Solapur, Burchanpur, Bhilwara, Kishangarh, Ludhiana, Amritsar and Panipat. The Government is also developing four handloom clusters, *i.e.*, Bhiwandi, Erude, Bhilwara and Ichalkaranji. The Government has also set-up 44 Powerloom Service Centres in different clusters for solving the problems of the weavers and for improving the technology level, skill development, design development, etc. The main emphasis is on Technology Upgradation Fund Scheme (TUFS) which has given much needed impetus to this sector.

4. Handlooms. Handloom symbolizes rich heritage and ethos of vibrant Indian culture. Due to the uniqueness and exclusivity of designs, capability to produce small batch sizes and having eco-friendly fabric, handloom products are in the high demand both in the domestic and international markets. This sector has made significant progress in the recent past with respect to quantity, quality and variety of its products. With about 15 per cent share of handlooms in textile production and major contribution to export earnings, this sector provides employment to 43.31 lakh persons engaged on 23.77 handlooms across the country. The fabric production which was witnessing downward trend due to economic slowdown in 2008 made a quick recovery in the post-slowdown period, and the production increased from 6,667 million square metres in 2008-09 to 6,936 million square metres in 2012-13. The export of handloom fabric also staged a smart recovery in the same period. Five Indian Institutes of Handloom Technology (IIHTs) at Varanasi, Salem, Guwahati, Jodhpur and Bargarh and 25 Weavers' Service Centres (WSCs) across the country are working to impart technical knowledge to weavers.

Locational Factors

Several factors, like availability of raw cotton, market, transport, etc. play a key role in the localisation of cotton textile industry. The significance of raw cotton is evident from the fact that 80 per cent of the industry is coterminous with the cotton growing tracts of the country. Some of the important centres such as Ahmedabad, Solapur, Nagpur, Coimbatore and Indore are located in the areas of large scale cotton cultivation. Mumbai is also not far away from the cotton producing areas of Maharashtra and Gujarat which have contributed a good deal in the localisation and growth of cotton textile industry here. It is equally important to note that cotton is a **pure raw material**, in the sense that it does not lose much of its weight in the process of manufacturing and the slight loss in weight is more than compensated by the use of sizing materials. There is not much of difference between the cost of transporting raw cotton and finished cloth. Both can be transported with equal ease and without adding much to the total cost of production. Hence, this industry normally tends to be located at such centres which have favourable transport facilities with respect to market. In other words, it is primarily a market oriented industry. With tropical and sub-tropical climate, all parts of India provide vast market potential for cotton textile industry. West Bengal, Bihar, Uttar Pradesh, Kerala and Odisha do not grow cotton and still have large number of big centres where cotton textile industry has flourished well. Thus although in earlier stages of industrialisation, cotton textile manufacturing was concentrated in Mumbai, it has witnessed great spatial spread and now covers almost the entire country. Since, it was a traditional cottage industry, cheap and skilled labour was readily available. The most notable feature of the distribution of the industry is that even within a state, the industry is localised within particular areas and regions, almost to the complete exclusion of others.

Dispersal of industry from the old nuclei started after 1921 with railway lines penetrating into the peninsular region. New centres like Coimbatore, Madurai, Bengaluru, Nagpur, Indore, Solapur and Vadodara were more favourably located in respect to raw material, market and labour than places of original locations. This industry also reached some places with some additional advantages, such as

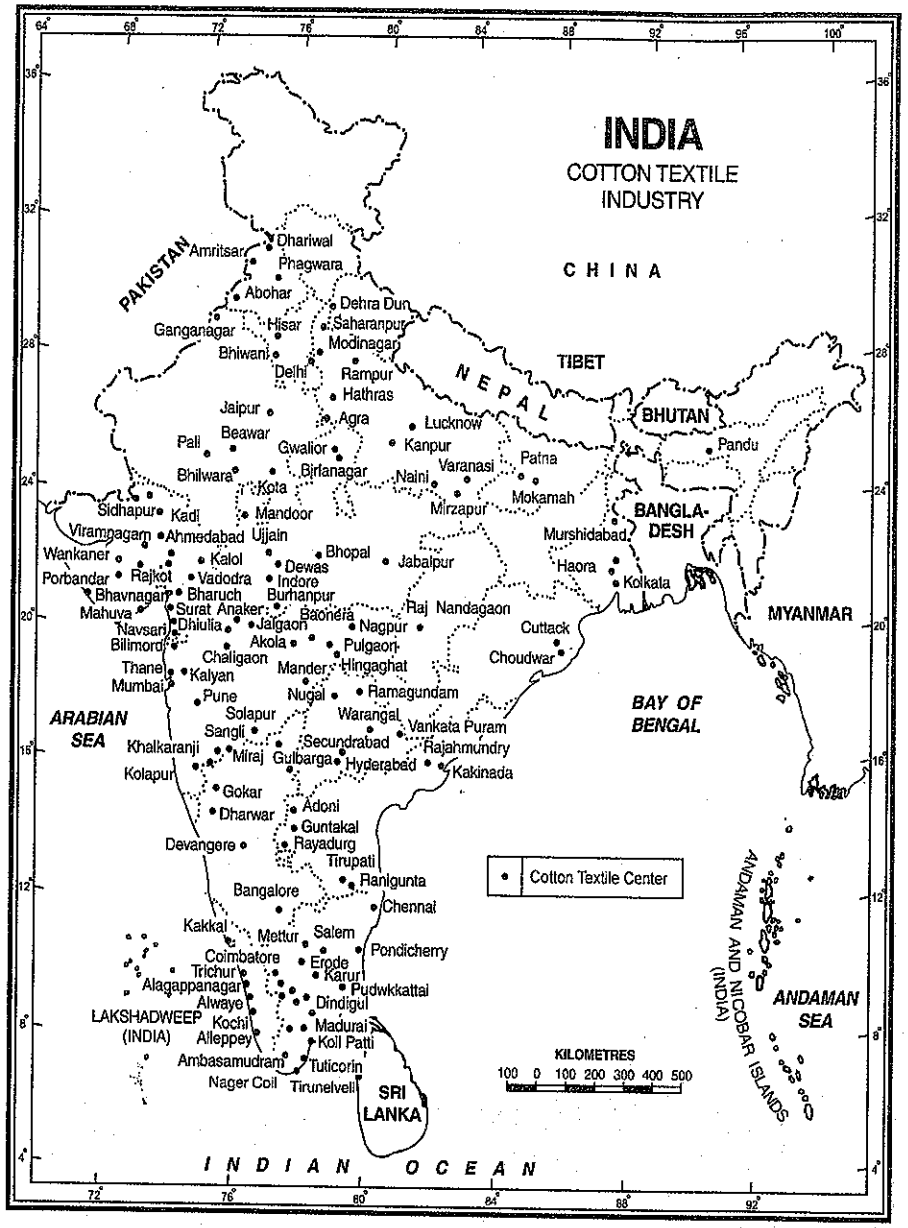


FIG. 25.1. India : Cotton Textile Industry

nearness to coal (Nagpur), financial facilities (Kanpur) and wide market with port facilities (Kolkata).

Dispersal of cotton textile industry was further boosted with the development of hydroelectricity. The growth of this industry in Coimbatore, Madurai and Tirunelveli is largely due to the availability of hydroelectricity from Pykara dam. The industry also tended to shift from areas of high labour cost to those with low labour cost. The labour cost factor played a crucial role in establishing this industry at Madurai, Turunelveli, Coimbatore.

Distribution

Although cotton textile mills are located in over 80 towns and cities of India, yet its larger concentration is found in Maharashtra, Gujarat, West Bengal and Uttar Pradesh. **Figure 25.1** shows the spatial distribution of cotton textile industry in India.

Maharashtra. Maharashtra excels all other states in the development of cotton textile industry. It produces 39.38 per cent mill cloth and 10.79 per cent yarn of India. About three lakh workers are engaged in this industry in Maharashtra. Mumbai is the largest centre in India having 63 mills out of Maharashtra's total of 122 mills. Mumbai is rightly called the ***Cottonopolis*** of India. Following are the main reasons of phenomenal growth of cotton textile industry in and around Mumbai.

(*i*) Mumbai enjoys humid climate which is helpful for this industry because thread does not break so frequently.

(*ii*) Mumbai is a very important port which helps in import of machinery and long staple cotton and export of cloth.

(*iii*) Cheap hydro-electricity is readily available from the nearby areas.

(*iv*) The black-cotton soil in the hinterland of Mumbai provides cotton as the basic raw material.

(*v*) Cheap labour can be drawn from the surrounding areas.

(*vi*) There is ready market for Mumbai products both in India and abroad.

(*vii*) Mumbai is well-connected by a network of roads and railways which help in easy transportation of raw material and finished goods.

(*viii*) Facilities for washing and dyeing also exist here.

(*ix*) There is no dearth of capital inputs.

(*x*) Mumbai has the advantage of an early start.

Apart from Mumbai, Solapur, Pune, Kolhapur, Satara, Wardha, Nagpur, Aurangabad, Amravati, Akola, Sangli, Chaligaon, Miraz, Mander, Jalgaon, etc. are other centres of cotton textile industry in Maharashtra.

Gujarat. Gujarat is the second largest producer of cotton textiles. This state accounts for over 33 per cent of the mill cloth and over 8 per cent of the yarn production of the country. Ahmedabad is the largest centre where 73 out of 118 mills of Gujarat are located. Ahmedabad is the second largest centre of cotton textile industry after Mumbai. Following facilities are available to Ahmedabad :

(*i*) Ahmedabad lies near the main cotton belt of India and there is no problem of obtaining raw cotton.

(*ii*) Climate is humid and is suited to this industry.

(*iii*) Cheap power is readily available.

(*iv*) Cheap and skilled labour is drawn from the nearby areas.

(*v*) Ahmedabad is served by a network of railways and roadways.

(*vi*) Land at Ahmedabad is much cheaper as compared to that in Mumbai.

(*vii*) Most of Ahmedabad mills produce cheap cloth which finds a ready market among the poor masses of India.

The other important centres of Gujarat are Vadodara, Bharuch, Surat, Rajkot, Porbandar, Maurvi, Bhavnagar, Viramgam, Sidhpur, Kelot, Kadi, etc.

Madhya Pradesh. Cotton is locally grown. Coal provides necessary energy. Abundant cheap labour is available due to backward economy of the masses. Gwalior, Ujjain, Indore, Dewas, Ratlam, Jabalpur, Bhopal, etc. are important centres.

Tamil Nadu. Among the southern states, Tamil Nadu is an important cotton textile producer. Although Tamil Nadu produces only about 6 per cent of the mill cloth of India, the state excels all other states in the production of yarn and accounts for over 44% of the total yarn production of the country. Coimbatore is the most important centre having 200 mills out of Tamil Nadu's 439 mills and is known as ***Manchester of South India.*** But Tamil Nadu's mills are of smaller size and give comparatively less production. Other important centres are Chennai (10

mills), Madurai, Tirunelveli, Tirucchchirappalli, Salem, Perambur, Tuticorin, etc.

West Bengal. *Kolkata is the most important* centre of West Bengal. It enjoys facilities of a port, humid climate, coal from Raniganj, local labour due to high density of population and those of dyeing and washing. But Kolkata suffers from the disadvantage of being away from the main cotton-producing areas of India. The other important centres are Haora, Murshidabad, Hugli, Sirampur, Shiampur and Panihar.

Uttar Pradesh. Most of cotton textile industry has developed in the western part of Uttar Pradesh. Kanpur is the largest centre and is known as ***Manchester of Uttar Pradesh***. This city has 10 out of 52 cotton textile mills of the state. Other important centres are Moradabad, Varanasi, Agra, Bareilly, Aligarh, Modinagar, Saharanpur, Rampur, Etawah, Lucknow, Mirzapur, etc.

Other producers are detailed as below:

Andhra Pradesh. Guntur, East Godavari and Udayagiri.

Kerala. Thiruvananthapuram, Alleppey, Kollam, Trichur, Alwaye.

Bihar. Gaya, Patna, Bhagalpur

Rajasthan. Pali, Beawar, Vijayanagar, Kishangarh, Ganganagar, Bhilwara, Udaipur, Jaipur, Kota, Ajmer.

Punjab. Amritsar, Ludhiana, Phagwara.

Haryana. Bhiwani, Hissar, Rohtak.

Karnataka. Bangalore, Belgaum, Mangalore, Chitradurga, Devangera, Gulbarga, Chennapatnam, Mysore.

Telangana. Hyderabad, Secunderabad.

Problems of Cotton Textile Industry

Although cotton textile is one of the most important industries of India, it suffers from many problems. Some of the burning problems are briefly described as under :

1. Scarcity of Raw Cotton. Indian cotton textile industry suffered a lot as a result of partition because most of the long staple cotton growing areas went to Pakistan. Although much headway has been made to improve the production of raw cotton, its supply has always fallen short of the demand. Consequently, much of the long staple cotton requirements are met by resorting to imports.

2. Obsolete Machinery. Most of the textile mills are old with obsolete machinery. This results in low productivity and inferior quality. In the developed countries, the textile machinery installed even 10-15 years ago has become outdated and obsolete, whereas in India about 60-75 per cent machinery is 25-30 years old. Only 18-20 per cent of the looms in India are automatic whereas percentage of such looms ranges from cent per cent in Hong Kong and the USA. to 99 per cent in Canada, 92 per cent in Sweden, 83 per cent in Norway, 76 per cent in Denmark, 70 per cent in Australia, 60 per cent in Pakistan and 45 per cent in China.

3. Erratic Power Supply. Power supply to most cotton textile mills is erratic and inadequate which adversely affects the production.

4. Low Productivity of Labour. Labour productivity in India is extremely low as compared to some of the advanced countries. On an average a worker in India handles about 2 looms as compared to 30 looms in Japan and 60 looms in the USA. If the productivity of an American worker is taken as 100, the corresponding figure is 51 for U.K. 33 for Japan and only 13 for India.

5. Strikes. Labour strikes are common in the industrial sector but cotton textile industry suffers a lot due to frequent strikes by a labour force. The long drawn strike in 1980 dealt a severe below to the organised sector. It took almost 23 years for the Government to realise this and introduce legislation for encouraging the organised sector.

6. Stiff Competition. Indian cotton mill industry has to face stiff competition from powerloom and handloom sector, synthetic fibres and from products of other countries.

7. Sick Mills. The above factors acting singly or in association with one another have resulted in many sick mills. As many as 177 mills have been declared as sick mills. The National Textile Corporation set up in 1968 has been striving to avoid sick mills and has taken over the administration of 125 sick mills. What is alarming is 483 mills have already been closed.

TABLE 25.6. Mega Cluster

Handlooms (4 Mega Cluster)	Handicrafts (5 Mega Clusters)	Powerloom (3 Mega clusters)
1. Varanasi (U.P.)	5. Moradabad (U.P.)	10. Bhiwandi (Maharashtra)
2. Sivasagar (Assam)	6. Nasarpur (Andhra Pradesh)	11. Erode (Tamil Nadu)
3. Murshidabad (West Bengal)	7. Bhdohi-Mirzapur (U.P.)	12. Bhilwara (Rajasthan)
4. Virudhnagar (Tamil Nadu)	8. Srinagar (Jammu & Kashmir)	
	9. Jodhpur (Rajasthan)	

Source : India 2012, A Reference Annual, p. 715.

Technical Textiles

Technical textiles are materials and products used for their technical performance and functional properties. These products are used in different fields such as aerospace, shipping, sports, agriculture, defence, medicine/health, manufacturing, etc. This sector of textile industry has huge potential and a bright future. The global size of technical textiles was about $ 136 billion and is growing at an average annual rate of 3.5 per cent. Domestic market for these textiles was ₹ 70,151 crore in 2012-13 and is growing at an average annual rate of 11 per cent. The Government of India launched an ambitious scheme known as Scheme for Growth and Development of Technical Textiles (SGDTT) during 2007-08 to exploit the vast potential of Technical Textiles.

Mega Cluster

The schemes for mega cluster support weavers/artisans, both in and outside the cooperative fold, including those in Self Help Groups (SHGs), Non-Governmental Organizations (NGOs) etc. The schemes provide for development of all the facets of selected clusters like raw material support, design inputs, upgradation of technology, infrastructure development, marketing support, welfare of weavers etc. At present, following 12 centres are being developed as Mega Cluster (**Table 25.6**).

Exports. India is a major exporter of cotton textiles. Cotton yarn, cloth and ready-made garments form important items of Indian exports. Indian garments are well known throughout the world for their quality and design and are readily accepted in the world of fashion. **Table 25.7** shows the export trends of cotton textile products from India. It is clear that export of ready-made garments has increased tremendously since 1960-61. In 2013-14, more than 62 per cent of the total export of cotton textiles consisted of ready-made garments.

India's textiles including handlooms and handicrafts are exported to more than hundred countries. However, the USA and the European Union account for about two-thirds of India's textile exports. The other major textile destinations are China, U.A.E. Sri Lanka, Saudi Arabia, Republic of Korea, Bangladesh, Turkey, Pakistan, Brazil, Hong-Kong, Canada and Egypt.

JUTE TEXTILES

This is the second important textile industry of India after cotton textile industry. This industry occupies a significant place in our economy and is one of the major industries in the eastern region, particularly in West Bengal. Jute the *golden fibre* meets all the standards of safe packaging in view of being a natural, renewable, biodegradable and

TABLE 25.7. Value of Cotton Textile Exports (₹ Crore)

Year	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2003-04	2012-13	2013-14
Cotton Yarn, Fabrics, made ups, etc.	65	142	408	2,100	16,030	13,160	21,624	40,947	53,914
Readymade Garments	1	29	550	4,012	25,478	52,861	65,613	70,343	90,402
Total	**66**	**171**	**958**	**6,112**	**41,508**	**66,021**	**87,237**	**1,11,290**	**1,44,316**

Source : The Economic Survey 2013-14, Statistical Appendix, pp. 75-77.

eco-friendly product. Globally, India is the largest producer of jute goods and this sector supports livelihood of about 40 lakh farm families and provides direct and indirect employment to 4 lakh workers.

Many of the sick and inefficient mills had to be closed down due to shortage of raw material. A relentless campaign to increase the production of raw jute by increasing area under jute cultivation in the Brahmaputra valley, West Bengal, Tarai and in East coastal areas and by increasing yield per hectare eased the situation to a great extent. The production of raw jute increased from 33 lakh bales (of 180 kg each) in 1950-51 to 108 lakh bales in 2013-14.

At present there are 83 composite jute mills in the country out of which 64 are in West Bengal, 7 in Andhra Pradesh, 3 each n Bihar and Uttar Pradesh, 2 each in Assam and Chhattisgarh and one each in Odisha and Tripura. As on January, 2012, total number of looms stood at 49,529 considing of 21,122 hessian looms, 26,663 sacking looms and 1,744 other looms.

Production and Distribution. Total production of jute goods in 2012-13 was 1,591.3 thousand metric tonnes which was 0.6 per cent higher than 1,582.4 thousand metric tonnes in 2011-12.

West Bengal has the largest concentration of jute industry. This state has 64 jute mills and 39,623 looms which respectively account for 81 per cent and 79 per cent of all India installation. Over 84 per cent of jute goods production of India comes from West Bengal. Andhra Pradesh is a distant second producing only 10 per cent of the Indian jute goods. Most of the mills are within a distance of 64 kilometres from Kolkata along the Hugli river. As a matter of fact, there is a narrow belt of jute mills which is 100 km long and 3 km wide along both the banks of Hugli river. Jute mills in the Hoogly region are much larger than mills in other parts of the country and give much higher production as compared to mills of other areas. Apart from Kolkata, the other important centres of jute textile industry are Titagarh (9 mills), Jagatdal (8 mills), Budge Budge (8 mills), Haora (8 mills), Bhadreswar (6 mills), Bally, Agarpara, Rishra, Serampara, Shibpur, Shyamnagar, Bansbaria, Kankinara, Uluberia, Naihati, Baidyahati and many others (**Fig. 25.2**).

Following few factors have been responsible for high concentration of jute mills in Hugli basin :

(*i*) The Ganga-Brahmaputra delta grows about over 73 per cent of India's jute and provides raw material to jute mills here.

(*ii*) Coal is obtained from Raniganj fields which are hardly 200 km away.

(*iii*) Cheap water transportation is available. The area is also served by a network of roads and railways (**Fig. 25.2**).

(*iv*) Abundant water is available for processing, washing and dyeing jute.

(*v*) Humid climate is very convenient for spinning and weaving.

(*vi*) Kolkata is a big port which helps in the import of machinery and spare parts and in the export of finished jute products.

(*vii*) High density of population in West Bengal and in the neighbouring parts of Jharkhand and Bihar provides abundant cheap labour. Some labour comes from Uttar Pradesh also.

(*viii*) Big capitalists are living in and around Kolkata which makes easy flow of capital in this industry.

(*ix*) Banking and insurance facilities are also available in and around Kolkata.

(*x*) The early arrival of British merchants under the aegis of East India Company in Kolkata helped in setting up this industry here. So Kolkata enjoys the advantage of an early start.

Andhra Pradesh has 7 mills located at Guntur, Vishakhapatnam, Nelimarla, Chillivelsa, Eluru, Ongole, and Chitvalshah.

Bihar has 3 mills at Katihar, Darbhanga and Samastipur.

Uttar Pradesh also has three mills which are located at Kanpur, Shahjawan (near Gorakhpur).

Assam has two mills. The main centre is at Gauripur.

Chhattisgarh also has two mills. The main centre is at Raigarh.

Odisha has only mill is at Cuttack. Tripura's sole mill is of new origin.

Problems of Indian Jute Industry

Indian jute industry is facing some very serious problems. Some of these are briefly described as under:

1. Most of the jute-producing areas went to Bangladesh (erstwhile East Pakistan) resulting in acute shortage of raw jute. Although successful efforts have been made to increase the supply of raw jute since Independence, it still falls short of our current requirements.

2. Most of our customers could not get our jute products during World War II as a result of which

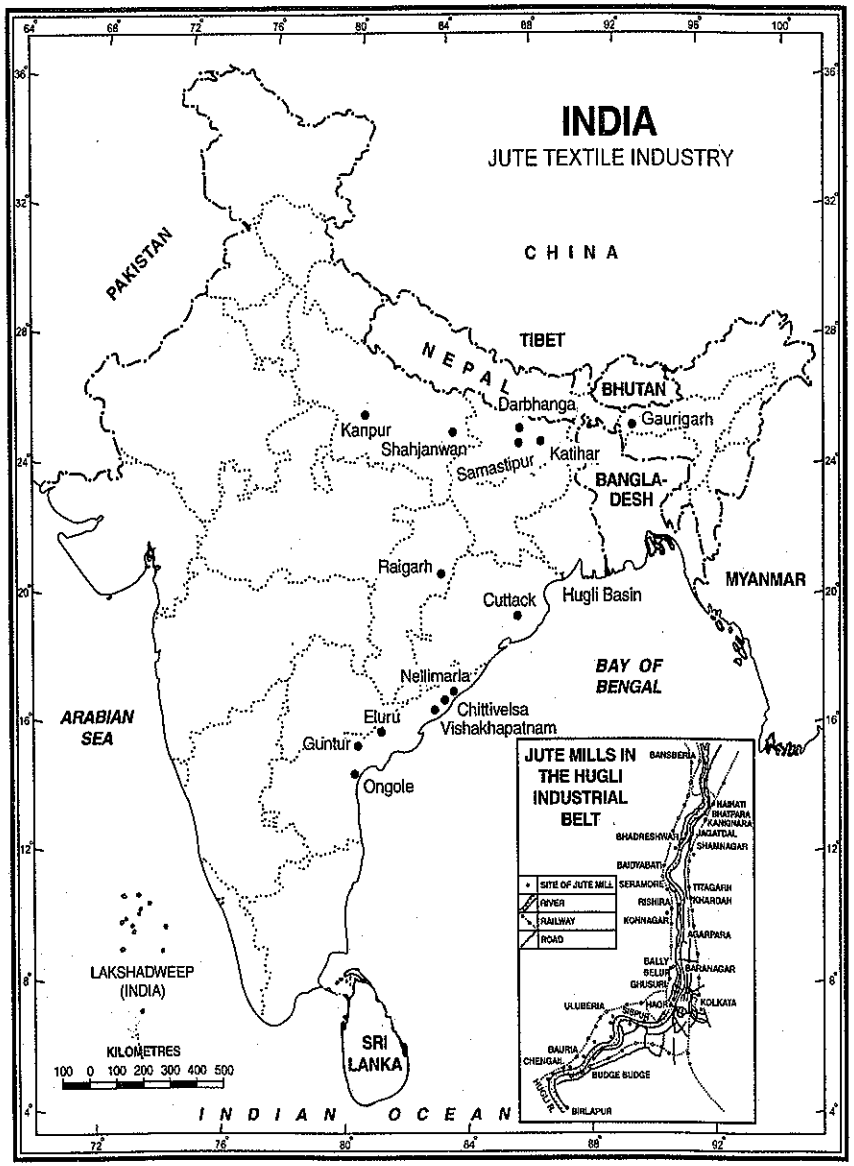


FIG. 25.2. India : Jute Textile Industry

TABLE 25.8. Exports of Jute Products

Year	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity in thousand tonnes	790	560	660	220	—	—	—	—	—
Value in ₹ crore	135	190	330	298	932	2,092	2,226	2,124	2,296

Source : Economic Survey 2013-14, Statistical Appendix pp. 75-77.

several countries developed many substitutes to jute. Even today, our jute industry has to face a very tough competition from synthetic packing materials of the advanced countries of Europe and North America. As such the market for jute goods has shrunk considerably.

3. The newly established mills and improved machines in Bangladesh are able to produce better quality goods at cheaper rates and have an edge over the Indian jute products in the international markets.

4. The overall demand for jute products is gradually decreasing in the international market.

5. The input cost for jute products in India is quite high.

In order to solve the above-mentioned problems, we have to increase the production of raw jute in India for which new areas are to be brought under jute cultivation. There is also an urgent need for replacing the old and obsolete machinery in order to compete quality wise. The National Jute Manufacturing Corporation has undertaken the modernisation of its units. Attempts are being made to diversify the product range, to improve the quality of goods, to reduce the cost and to develop new products.

Exports

It is traditionally an export oriented industry and its survival largely depends upon its export performance. The rise and fall of the industry is closely linked with demand for jute goods in the international and national market. India lost much of her market as a result of World War-II and owing to sharp rise in synthetic substitutes as packing materials. **Table 25.8** shows that there has been sharp decline in the quantity of jute goods exported by India from 660 thousand tonnes in 1980-81 to 220 thousand tonnes in 1990-91. The earnings from export of jute goods also declined from ₹ 330 crore to ₹ 298 crore during the same period. However, situation improved afterwards and earnings from export of jute goods increased to ₹ 2,092 crore in 2010-11 and further to ₹ 2,296 crore in 2013-14.

Some of the advanced countries are becoming conscious about the environmental degradation with the increasing use of non-biodegradable materials such as plastic bags for packing and are trying to discourage such a practice. This has once again turned the tide in favour of jute bags in some advanced countries and India's jute industry is poised for a big boost in the years to come. The main buyers of Indian jute products are the USA, Canada, Russia, UAR, Australia, U.K., Czech Republic, Slovakia, etc.

The Government on June 2, 2006, approved the implementation of the Jute Technology Mission (JTM) at an estimated cost of ₹ 355.56 crores. The mission has the following four mini-missions :

(*i*) Mini-mission I, implemented on November 9, 2006 is concerned with strengthening of Research and Development (R&D).

(*ii*) Mini-mission II, implemented on December 21, 2006 is concerned with Transfer of Technology.

(*iii*) Mini-mission III implemented on February 6, 2007 aims at Development of Marketing Infrastructure.

(*iv*) Mini-mission IV also implemented on February 6, 2007 is devoted to Modernisation/Upgradation of Technology of Jute Sector and initiation of activities for promotion of Jute Diversified Products.

WOOLLEN TEXTILES

Growth and Development

Woollen textile is one of the oldest industries of India. There is evidence to prove that Aryans inhabiting the Indus Valley knew the use of wool as far back as 5000 B.C. Woollen textiles were quite popular as cottage industry in India during the

historical times. However, the modern woollen textile industry started with the establishment of 'Lal Imli' at Kanpur in 1876. It was followed by setting of woollen textile mills at Dhariwal (Punjab) in 1881, Mumbai in 1882 and Bengaluru in 1886. The industry could not make much headway till the Second World War. Rapid progress has been observed during the planning era. At present there are 621 big and small mills, 1,100 hosiery units and 155 yarn spinning units.

Distribution

The main concentration of woollen textile industry is found in Punjab, Maharashtra and Uttar Pradesh. These states account for about three-fourths of the total spindleage capacity. Gujarat, Karnataka, West Bengal and Jammu and Kashmir are next in order of importance.

Punjab. Punjab leads all other states in manufacturing woollen goods. There are currently 257 big and small mills and the state possesses about half of the total spindleage installed capacity. Dhariwal is the largest centre. The other centres are Amritsar, Ludhiana and Kharar. The industry enjoys the benefit of hydroelectricity from Bhakhra Nangal Dam and wool from Kashmir and Kumaon regions.

Maharashtra. Maharashtra is the second largest producer of woollen textiles. The state has 31 mills, most of which are located at Mumbai. Better quality woollens are manufactured from the imported wool. Being an important port, Mumbai facilitates the import of wool which mainly comes from Australia, Italy and U.K. Shoddy and inferior goods are manufactured from the indigenous wool.

Uttar Pradesh. Kanpur in Uttar Pradesh is the birth place of modern woollen textile industry in India and is the largest centre in the state. The other centres are Shahjahanpur, Mirzapur, Varanasi, Agra, Modinagar and Tanakpur. As many as 37 mills are engaged in manufacturing different varieties of woollen goods in the state.

Gujarat. Gujarat has 10 mills located at Jamnagar, Ahmedabad, Kalol and Vadodara. Jamnagar specializes in worsteds, blankets and shoddy goods. Inferior wool is obtained from Rajasthan and Kathiawar while superior wool is imported from abroad.

Others. ***Haryana*** has 160 small mills located mainly at Panipat, Faridabad, Gurgaon and Bahadurgarh. ***Rajasthan's*** 72 mills are scattered over Bikaner, Alwar, Bhilwara, Sikar, Jaipur and Nagaur. Pushkar and Ajmer have handloom units producing mainly coarse blankets. Bengaluru and Bellary are important centres of ***Karnataka.*** The north-eastern parts of the state produce large quantities of coarse wool which helps in establishing handloom industry. Superior wool is imported. Most of the woollen textile centres of ***West Bengal*** are concentrated in the Hugli basin especially in Kolkata and Haora. The state has 6 mills in all. Kolkata is famous for shoddy goods, blankets, serges and flannels. ***Jammu and Kashmir*** is an important producer of handloom and powerloom woollen goods. Kashmiri woollen products are prepared from fine quality wool which is locally available. They are very attractive and find ready market throughout the country. Srinagar has 2 large mills in public sector. Kulu in ***Himachal Pradesh*** is famous for shawls. In ***Tamil Nadu,*** Chennai and Salem are important centres.

Woollen Carpets and Felts (Namdahs)

It is primarily a cottage industry and flourishes in areas where cheap skilled labour is readily available. There are about 240 units engaged in manufacturing woollen carpets and felts. The important carpet producing centres are Mirzapur, Gopiganj, Shahjahanpur, Agra, Bhadohi, Kanpur and Khamana in **Uttar Pradesh**; Jaipur, Jodhpur, Bikaner and Deogarh in **Rajasthan**, Srinagar in **Jammu and Kashmir**; Amritsar in Punjab; Panipat in **Haryana**; Eluru and Warangal in **Andhra Pradesh**; Obra and Danapur in Bihar; Bengaluru, Mysore and Bellary in **Karnataka**; Chennai and Wallanghpet in **Tamil Nadu** and Gwalior in **Madhya Pradesh**. About 90 per cent of the total production is exported mainly to the USA, Britain, Canada and Australia.

Hosiery Goods

There are about 1,100 hosiery units manufacturing a variety of products like jerseys, sweaters, pullovers, shawls, cardigans, caps, socks, gloves, mufflers, etc. Over 90 per cent units are located in Punjab and Haryana. The rest are scattered over Uttar Pradesh, West Bengal, Delhi and Maharasthra. Ludhiana in Punjab is the largest centre of hosiery manufacturing in India.

Pashmina Wool Development Scheme. India produces in finest quality of pashmina wool which comes mainly from the Ladakh region of Jammu and Kashmir. This region has about 2.45 lakh pashmina goats which produce 40 to 50 tonnes of raw pashmina every year. To solve the problem of the pashmina goat rearing tribal people and to popularize this high quality wool in other non-traditional regions, the Government has taken up a pashmina development package in the 12th Five Year Plan (2012-17).

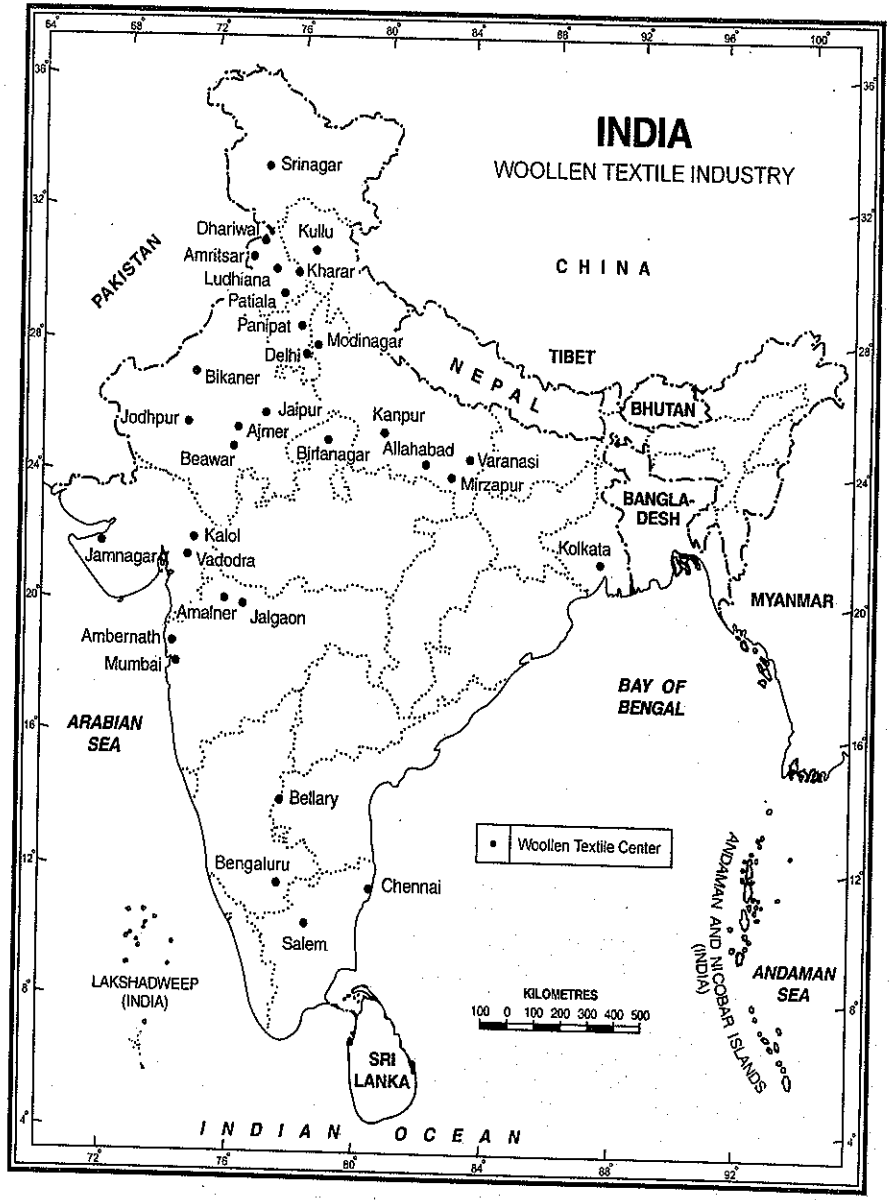


FIG. 25.3. India : Woollen Industry

Trade (Imports and Exports)

India does not produce quality raw wool in sufficient quantity and has to import large quantities of fine wool mainly from Australia. But India is an important exporter of woollen goods. The important items of export are woollen fabrics, hosiery and knitwear, druggets, carpets, shawls, blankets, *lohis*, *mandahs*, etc.

The USA., Russia, U.K., Canada, Australia, Germany, Denmark, Sweden, Chech Republic, Slovakia, France, Belgium, the Netherlands and some West Asian and African countries are the chief buyers of Indian woollen goods.

Problems of Woollen Textile Industry

1. Shortage of raw wool. As mentioned earlier, India does not produce sufficient quantity of fine quality raw wool. Also the productivity of Indian sheep is very low. On an average, an Indian sheep yields only 0.86 kg of wool per annum against 4.08 kg yielded by an Australian sheep. Large proportion of wool produced in India is of inferior quality and does not conform to international standards.

2. Lack of Market. Most parts of India have tropical and sub-tropical climate which restricts the demand for woollen clothes. The southern part of the country enjoys warm weather throughout the year and people do not require woollen clothes at all. Even in the northern parts of India, the winter season lasts only for four to five months in a year and it is only during this period that woollen clothes are required to some extent. The hot weather lasting for 7 to 8 months is the slack period during which production is carried out mainly for the Armed Forces and for export. For practical purposes, woollen textile industry is a seasonal phenomena in India.

3. Lack of Modern Equipment. Most of the equipment in woollen textile industry, like other textile industries, is obsolete and outdated as a result of which, its products are not able to cope with the everchanging designs and patterns, especially in the international market. There is an urgent need for mechanisation of the carpet industry keeping in view the rising demand to put a ban of the child labour. This will also help to increase the production and improve the quality.

4. Low Quality. Leaving aside a few exceptions, Indian woollen goods are considered to be of low quality in the international markets which results in lack of demand. Indian knitwear is often not shrink resistant, moth-proof and fast-coloured.

SILK INDUSTRY

India has been well-known for the production of silk since ancient times. Rulers of the medieval period encouraged this industry. India enjoys the distinction of being the only country producing all the five known commercial varieties of silk, *viz.*, Mulberry, Tropical Tasar, Oak Tasar, Eri and Muga (of which golden yellow muga silk is unique to India). India's total silk production amounting to about 17 per cent of the world production, ranks India as the second largest producer of raw silk, next only to China. Sericulture is a labour intensive industry and provides employment to nearly 7.56 million persons mainly to weaker and marginalized sections of society. Indian silk industry has improved manifold since Independence from raw silk production level of 1,437 metric tonnes during the first Five Year Plan to 23,060 metric tonnes at the end of the 11th Five Year Plan. In the year 2012-13 India produced 18,755 metric tonnes of mulberry silk and 4,924 metric tonnes of non-mulberry silk which included 1,705 metric tonnes of tasar 3,100 metric tonnes of eri and 119 metric tonnes of muga silk. Thus it is clear that nearly 80 per cent of the country's total silk is mulberry silk which is produced mainly in the states of Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu and Jammu and Kasmir. Tasar, eri and muga are collectively called ***vanya*** (wild) silk as these silks are mostly the products of the forests. These varieties are popular for their unique colour, lustre and are available in natural colours like golden brown, mauve, cream and beige. ***Tasar silk*** is largely produced in Jharkhand, Chhattisgrh, Madhya Pradesh, Bihar and parts of Odisha where it has great potential to enhance the livelihood of the tribal population. Idling women folk and unemployed youth are attracted towards tasar culture to a greater extent. The **oak tasar** culture is now practised in the sub-Himalayan states like Manipur, Himachal Pradesh, Uttar Pradesh, Assam, Meghalaya and Jammu and Kashmir. ***Eri silk*** ranks first among non-mulberry silk production and is produced mostly in hill tracks of the

north-eastern states besides some parts of Bihar, West Bengal and Odisha.

Mugas silk, also known as golden silk is exclusively found in Assam and is widely distributed in the Brahmaputra valley.

Distribution

There are nearly 90 mills producing silk textiles. In addition, there are small and medium sized units also. It is also popular in the shape of handloom industry. About 98 per cent of the total production comes from Karnataka, West Bengal and Jammu and Kashmir.

Karnataka is the foremost silk producing state in India. It produces only mulberry silk and accounts for over 50 per cent of mulberry silk of the country. Mulberry trees grow over 8.5 thousand hectares. Mysore, Bengaluru, Kolar, Mandya, Tumkur, Belgaum and Kodagu districts are the main producers. About 50 per cent of India's silk cloth is also manufactured in this state. The main centres of silk cloth manufacturing are Bengaluru, Kolar, Mysore and Belgaum. ***West Bengal*** produces about 13 per cent of country's total silk, most of which is of mulberry variety. There are about five thousand handlooms mainly concentrated in Murshidabad, Bankura, 24 Parganas and Birbhum districts. ***Jammu and Kashmir*** has its main silk textile centres in Anantnag, Baramula, Jammu and Udhampur districts. Srinagar is a big centre for silk manufacturing where automatic machines are used for this purpose. ***Bihar*** is also an important producer. Patna, Gaya and Bhagalpur are the leading silk producing districts. In the neighbouring ***Jharkhand***, Ranchi, Palamu and Hazaribagh are important producers. ***Chhattisgarh*** produces about 2.6 per cent of India's silk, most of which comes from Bastar, Bilaspur and Surguja districts. The other areas of silk production are Mirzapur, Pratapgarh and Shahjahanpur in ***Uttar Pradesh***; Amritsar, Jalandhar, Ludhiana, Hoshiarpur and Gurdaspur in ***Punjab***; Goalpara, Kamrup and Nowgong in ***Assam***; Coimbatore, Tiruchirapalli, Dharmapur, Nilgiris, Salem, Thanjavur and Tirunelveli in ***Tamil Nadu***; Nagpur, Pune, Sangli, Chandrapur and Solapur in ***Maharashtra***; Ahmedabad, Surat, Bhavnagar, Porbandar in ***Gujarat***; Chittur, Kurnool, Vishakhapatnam and Anantpur in ***Andhra Pradesh***, Warangal, Adilabad and Karimnagar in ***Telangana*** and Balaghat in ***Madhya Pradesh***. ***Meghalaya, Manipur, Tripura and Himachal Pradesh*** also produce some quantity of silk.

Exports

The Indian silk is demanded in American, European as well as Asian markets. The USA, UK, Russia, Saudi Arabia, Kuwait and Singapore are the major importers of silk dress materials and scarves. The tough competition with Italy and Japan caused a setback to Indian silk industry. The synthetic fibres and the artificial silk being less expensive and easy to maintain, have been responsible for reducing the popularity of silk.

Man-Made Fibres

It is an important segment of textile industry. Man-made fibres have revolu-tionised the textile industry because they are in great demand due to their special qualities like strength, durability, dyeability and workability. Over and above, they are resistant to shrinkage.

Raw Materials. Man-made fibres are generally divided into two groups *viz*., cellulose (rayon and acetate) and non-cellulose (nylon, polyster, etc.) The basic raw material for producing viscose rayon yarn is the cellulose pulp derived from bamboo, eucalyptus and other soft wood trees. The chemicals used for making these fibres include caustic soda, sodium sulphate, sulphuric acid, carbon disulphide and soda sulphate. For acetate yarn and staple fibre, the primary raw materials are alcohol and cotton linters. The other materials are acetic acid, acetic acetone and ethyl acetate. For the production of synthetic fibres like nylon, polyester, acrylic, etc. we require caprolactum, naphtha, polyster chips, ethylene, glycole, etc.

Growth and Development

The man made fibre weaving units were started between 1925 and 1935 when the cost of pure silk fabrics became exorbitant. The powerlooms and handlooms had been using imported fibre till 1950 when a factory was established by Travancore Rayons Ltd. at Rayapuram in Kerala to manufacture synthetic fibre. This was followed by National Rayon Co. at Mumbai and the Sirsilk Ltd. at Hyderabad. By 1960, Century Rayon Ltd. at Kalyan (Maharashtra), the

Gwalior Rayon Silk Manufacturing Company at Nagda were also commissioned. Following units are making a significant contribution towards the manufacturing of synthetic fibres.

(*a*) **Rayon Units.** Kagaznagar (Telangana), Junagadh (Gujarat), Rayapuram (Kerala), Udhna (Gujarat), Birlagram (H.P.), Nagda (M.P.), Kalyan, Pimpri-Pune and Goregaon (Maharashtra), Kota (Rajasthan), Mettupalayam (Tamil Nadu), Kanpur (U.P.) and Tribeni (W. Bengal).

(*b*) **Nylon Filament Yarn Units** Kota, Pimpri, Pune, Bhonsari-Pune, Modinagar, Mumbai, Nagpur,

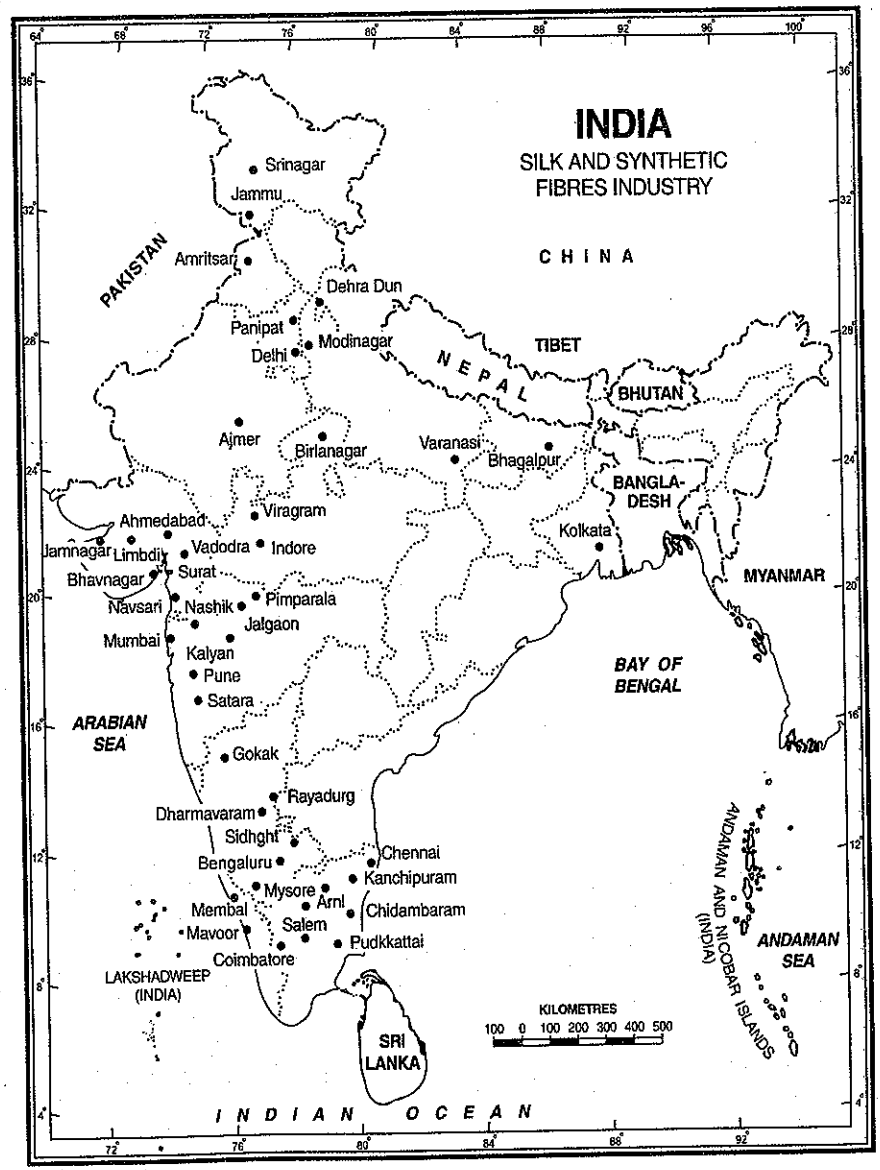


FIG. 25.4. India : Silk and Synthetic Fibres Industry

TABLE 25.9. Production of Man-made Fibre and Yarn (Thousand tonnes)

Year	Filament Yarn		Staple Fibre	
	Cellulose	Synthetic	Cellulose	Synthetic
1950-51	Neg.	N.A.	N.A.	N.A.
1960-61	21	N.A.	22	N.A.
1970-71	38	10	62	5
1980-81	43	32	83	32
1990-91	51	227	160	177
2000-01	55	865	236	666
2005-06	53	1,103	229	736
2006-07	54	1,303	247	889
2007-08	51	1,448	280	961
2008-09	42	1,360	233	830
2009-10	43	1,465	302	963
2010-11	41	1,496	305	976
2011-12	42	1,408	323	907

Neg. : Negligibly small, N.A. : Data Not Available.
Source : The Economic Survey 2012-13, p. A-33.

Vadodara, Bengaluru, Chennai, Hyderabad, Thiruvananthapuram, Barauni, Kanpur, Ujjain and Kolkata.

(*c*) **Nylon Staple Fibre Units.** Kota, Mumbai.

(*d*) **Nylon Tyre Cord Units.** Kota, Mumbai, Chennai, Kalyan, Kanpur, Goregaon, New Delhi, Udhna.

(*e*) **Polyster Staple Fibre Units.** Thane, Ahmedabad, Vadodara, Ghaziabad, Mandi, Kota.

(*f*) **Polyster Filament Yarn Units.** Mumbai, Kota, Pimpri-Pune, Modinagar, Ujjain, Udhna, Vadodara.

Man-made fibre industry has made manifold progress as is evident from **Table 25.9**.

India has to import large quantity of man-made fibres to meet the growing demand in the home market.

METALLURGICAL INDUSTRIES

Metallurgical industries are those industries which use metal as the basic raw material. It is a very wide term and includes several industries like iron and steel, aluminium, copper smelting, lead and zinc smelting, alloy, ferro-manganese, ferro-silicon, ferro-chrome, tungsten and a host of other industries. These industries form the *economic backbone* of a developing country. India has progressed a lot especially during the planning period and now occupies a place of pride with regard to the development and growth of metallurgical industries. Major metallurgical industries are briefly described in the following pages :

IRON AND STEEL INDUSTRY

We live essentially in an age of iron and steel. "Because of its hardness, strength and durability, because of the ease with which it can be cast and worked into any desired shape and because of its remarkable cheapness under modern methods of production, iron is the most important and widely used metal in the service of man". Iron and steel were the harbinger of industrial revolution in late 18th and early 19th century. Today this industry has proved to be the harbinger of globalisation. It is one of the very few industries that have assumed a global character with developments in one region affecting the industry almost everywhere else; and India is no exception. The proud machine civilization of modern age would not have existed without iron. The sturdy structure of modern industrial world is made of steel.

Iron and steel is the **basic or key industry** and lays the foundation of a vibrant industrial economy. Most of the subsidiary industries such as automobiles, locomotives, rail tracks, ship-building, machine building, bridges, dams and a host of other industrial and commercial activities depend upon iron and steel industry. No wonder, per capita consumption of iron and steel is one of the most significant measures of the level of industrialisation and economic growth of a country.

Although Indians are known for their technique of smelting iron since early time, the first iron and steel unit on modern lines was established in 1830 at Porto Nova in Tamil Nadu. However, it could not succeed and was closed down in 1866. The other efforts made during the second half of the 19th century also met with the same fate.

The real beginning of modern iron and steel industry was made in 1907 only when Tata Iron and Steel Company (TISCO) was set up at Jamshedpur (Sakchi at that time). The Indian Iron and Steel Company (IISCO) was set up in 1919 at Burnpur followed by the setting up of Mysore Steel Works at Bhadravati (now Visveswaraya Iron and Steel Works) in 1923. Iron and steel Industry witnessed rapid growth after Independence. India produced 16.9 lakh tonnes of pig iron in 1950-51. The development of iron and steel industry was envisaged during the first Five-Year Plan, but it was during the Second Five-Year Plan, that the three integrated steel projects were started at Bhilai, Rourkela and Durgapur. India is now the eighth largest producer of steel in the world. Recent developments have amply demonstrated the mettle of Indian steel industry to rise even further and become a major player in the world. However steel is known to be an industry witnessing periodic business cycles of upswings and downswings.

Steel Authority of India (SAIL) Established in 1973, SAIL is a government undertaking and is responsible for the management of steel plants at Bhilai, Durgapur, Rourkela, Bokaro and Burnpur and also the Alloy Steel Plant at Durgapur and Salem Steel Plant. The management of Indian Iron and Steel was taken over by Government on 14th July, 1976.

TABLE 25.10. Progress of Iron and Steel Industry in India

Year	Hot metal (including Pig iron) in Million tonnes	Crude Steel (Million tonnes)	Semi-finished steel (main plants) Million tonnes	Finished steel (including secondary producers) in Million tonnes	Steel castings (Thousand tonnes)
1950-51	1.7	1.5	1.2	1.0	N.A.
1960-61	4.3	3.5	1.0	2.4	35.0
1970-71	7.0	6.1	0.9	4.6	62.0
1980-81	9.6	10.3	2.0	6.8	71.0
1990-91	12.2	N.A.	4.3	13.5	262.0
2000-01	22.6	30.6	3.3	32.3	352.4
2005-06	36.5	46.5	3.2	46.6	449.5
2006-07	39.7	50.8	3.1	52.5	612.0
2207-08	42.1	53.9	2.8	56.1	567.0
2008-09	43.3	58.4	3.2	57.2	1,592.0
2009-10	47.4	65.8	4.1	60.6	1,486.0
2010-11	42.9	70.7	4.3	68.6	598.0
2011-12	42.5	73.8	4.5	73.3	770.0

N.A. : Data Not Available.
Source : Economic Survey 2012-13, p. A-31.

SAIL also took over Maharashtra Elektrosmelt Limited, a mini steel plant, in January 1986. Visweswaraya Iron and Steel Limited was also taken over by SAIL in August 1989.

With the introduction of new liberalised industrial policy in 1991, some changes were visualised in the functioning of SAIL which had great impact on the performance of steel industry in the country. Over a period of five years it brought down its manpower by around 40,000 and substantially improved its techno-economic parameters to contain its cost of operation in spite of a steady rise in input prices.

Locational Factors

Iron and steel industry uses large quantities of heavy and weight losing raw materials and its localisation is primarily controlled by the availability of raw materials. Coal and iron ore are the two basic raw materials used by iron and steel industry and on the basis of minimum transportation cost, most of the steel plants are located at three distinct places *viz.* (*i*) near coal fields, (*ii*) near iron ore mining centres and (*iii*) at places between areas of coal and iron ore production. Most of the iron and steel plants of India such as Jamshedpur, Burnpur, Durgapur, Rourkela, Bhilai and Bokaro are located in Jharkhand, West Bengal, Odisha and Chhattisgarh. These states are very rich in coal and iron ore deposits and are important producers of these materials. Visveswaraya Iron and Steel Works at Bhadravati is a major exception which is located far away from the main coal producing areas of the country. Earlier, this centre was depending upon charcoal which was available locally. Now it uses hydroelectricity from the Sharavati Power Project. The other raw materials used in this industry are manganese, limestone, dolomite, chromite, silica, etc. These raw materials are used in small quantities and can be transported without much difficulty. Hence, they do not materially affect the localisation of this industry.

Another important factor influencing the localisation of iron and steel industry is the availability of market. Steel products of an integrated steel plant are quite bulky and it has been estimated that the transport cost per tonne-kilometre of steel product is about three times more than that of coal or iron ore. Thus, following the theory of *minimum transprotation cost* many centres of iron and steel production tend to be attracted by market. Moreover, recent technological developments in transport, the use of scrap as raw material and the agglomeration economics have made market oriented location more advantageous than ever before. With the increasing popularity of open hearth process, scrap has become a very important raw material in this industry *About half of the metal now melted in world's iron and steel furnaces is scrap*. Industrialized areas, specially with steel consuming industries, are the major sources of scrap iron. Thus, the market has double attraction, as the consumer of steel and as a source of raw materials. However, the use of scrap as raw material on a large scale is yet to pick up in India.

From the above discussion, it is clear that in the present day localization of iron and steel industry, each of the three factors *viz.*, coal, iron ore and market has almost equal significance. The geographical coincidence of any two of the three factors would easily determine the site of the steel plant.

In another situation, when some ingredients are to be imported or finished steel is to be exported, sea port locations are preferred. This is exemplified by the establishment of the Vishakhapatnam Steel Plant at a sea port. A few more plants in the offing such as Mangalore and Ratnagiri also favour seaboard location.

Centres of Production

At present there are 10 primary integrated plants and a large number of decentralised scondary units known as mini steel plants. Besides, there are several rolling and re-rolling mills and foundries which manufacture different items of steel using pig iron and ingot steel. There are about 10,000 foundries, 95 per cent of which are concentrated in the western states of Maharashtra and Gujarat and in the southern state of Tamil Nadu.

Large Integrated Iron and Steel Plants

1. Tata Iron and Steel Company (TISCO). This is the oldest iron and steel centre of India. It is a private sector enterprise. It was established in 1907 by Jamshedji Tata at Sakchi in Singhbhum district of

Jharkhand. Later on, it was renamed as Jamshedpur after Jamshedji. It started producing pig iron in 1911 and steel in 1912. The plant initially had capacity of producing 1.21 million tonnes of pig iron and 1.1 million tonnes of steel per annum. This capacity has been enhanced to 3.9 million tonnes of pig iron, 2 million tonnes of ingot steel and 3 million tonnes of saleable steel. Currently it produces about 3 million tonnes of saleable steel. Following facilities are available to this centre :

(*i*) High grade haematite iron ore is available from Noamundi mines of Singhbhum in Jharkhand and Gurumahisani mines of Mayurbhanj in Odisha. These mines are located at a distance of 75-100 km from Jamshedpur.

(*ii*) Coal is available from Jharia and Raniganj coal mines located 160 to 200 km from Jamshedpur.

(*iii*) Manganese comes from Joda mines of Kendujhar district in Odisha.

(*iv*) Dolomite, limestone and fire clay used as flux material are available from Sundargarh district of Odisha.

(*v*) Kolkata, located at a distance of 250 km, provides port facilities and its industrialised hinderland provides market for the products.

(*vi*) Sufficient water for cooling purposes is obtained from Subarnrekha river. In addition to this, the storage dam on Kharkai river also provides water.

(*vii*) Jamshedpur is well connected with Kolkata, Mumbai and Chennai by road and rail and enjoys good transport facilities.

(*viii*) Densely populated regions of Jharkhand, Bihar and Odisha provide cheap labour. Major part of labour is drawn from tribal areas of Chota Nagpur plateau.

Dubari Steelworks. The shortage of space in Jamshedpur and some other allied factors persuaded TISCO to locate a second steelworks at Gopalpur in Odisha, about 170 kms south-east of Bhubaneshwar. The favourable factors are coastal location, proximity to a rich iron ore belt, availability of sparcely settled land for the project, a nearby source of fresh water in the form of a rivulet, proximity to the trunk rail line and a national highway and the presence of a minor deep water port which could be expanded. Tata Steel acquired land near Gopalpur to set up a shore based steel plant in 1997 but shelved the project later due to slow pace of development of Gopalpur port and a resistance movement by local people. Consequently the Tata Steel decided to build a six million tonne plant at Dubari. The infrastructure included development of the Dhamra port and a railway line between Dhamra and Bhadrakh. This plant will use the latest technology and will be cost competitive with the most efficient steel plants in the world.

2. Indian Iron and Steel Company (IISCO). Three plants at Kulti, Hirapur and Burnpur in West Bengal were set up in 1864, 1908 and 1937 respectively. These plants have been merged together and are known as Indian Iron and Steel Company (IISCO). It was brought under government control and management in July 1972. The three plants are linked by Kolkata-Asansol railway line. Hirapur plant produces pig iron which is sent to Kulti for making steel. The rolling mills are located at Burnpur. IISCO enjoys the following advantages :

(*i*) Iron ore is available from Guna mines in Singhbhum district of Jharkhand located at a distance of 285 km. Some iron ore is also obtained from Mayurbhanj area of Odisha.

(*ii*) It used to receive coal from Jharia, located at a distance of 137 km but now the power from the Damodar Valley Corporation is extensively used.

(*iii*) Dolomite and limestone are obtained from Sundargarh district of Odisha which is 327 km away. Limestone is also available from Gangpur and Paraghat areas of Odisha.

(*iv*) Rail and road links connect it to Kolkata which is just 200 km away.

(*v*) Cheap labour is readily available from the neighbouring areas.

IISCO has annual capacity of producing 10 lakh tonnes of steel. Currently it produces over 4 lakh tonnes of pig iron, more than 3.5 lakh tonnes of crude steel and around 3.8 lakh tonnes of saleable steel.

3. The Visweswaraya Iron and Steel Ltd. It was established as Mysore Iron and Steel Company

(MISCO) in 1923 by the erstwhile state of Mysore. It is located at Bhadravati on the banks of river Bhadravati in Shimoga district of Karnataka. This plant was brought under Government control in 1962 and was renamed as Visveswaraya Iron and Steel Ltd. after the name of great engineer Dr. Visweswaraya. This plant has got a capacity of 1.38 lakh tonnes of steel. There are plans to raise its capacity to two lakh tonnes. This centre enjoys the following advantages.

(*i*) Bhadravati valley is 13 km wide as a result of which enough land is available.

(*ii*) High grade haematite iron ore is brought from Kemmangundi mines in Chikmaglur which is just 40 km away.

(*iii*) At the time of the setting up of the plant in 1923 the charcoal obtained from the forest-wood was used for smelting because coal was not available. Now it uses hydroelectric power obtained from Sharavati Power Project.

(*iv*) Limestone is available from Bhundiguda just 25 km away.

(*v*) Shimoga and Chitradurga supply manganese. These areas are just 50 km away.

(*vi*) Dolomite and chromite are also available within a radius of 45-50 km.

(*vii*) It lies on the main Biru-Shimoga railway line and makes use of railway facilities.

In order to increase the production of iron and steel, the Government of India established ***The Hindustan Steel Limited*** in public sector. Consequently, three plants under the public sector, *i.e.* Bhilai, Rourkela and Durgapur came into operation during the Second Five Year Plan. Capacity of each plant was fixed at 10 lakh tonnes of steel which was expanded during the Third Five Year Plan and a proposal of setting up a steel plant at Bokaro was also made.

4. Bhilai. Bhilai iron and steel centre was set up in Durg district of Chhattisgarh in 1957 with the technical and financial support of the then Soviet Union. It started production in 1959. Its initial capacity was 10 lakh tonnes which has been raised to 52 lakh tonnes. Durg happens to be a backward area and the purpose of setting this plant was to bring prosperity to this area. It enjoys following geographical advantages :

(*i*) It procures rich haematite iron ore from Dalli-Rajhara range which is 80 km south of Bhilai.

(*ii*) Coal is obtained from Korba and Kargali fields of Chhattisgarh located at 225 km away. Bokaro and Jharia (720 km) also supply coal.

(*iii*) Limestone comes from Nandini mines hardly 24 km away.

(*iv*) Bhandara of Maharashtra and Balaghat of Madhya Pradesh supply manganese.

(*v*) The Korba Thermal Power station is the main source of power.

(*vi*) It is connected with Kolkata-Nagpur railway line.

(*vii*) Dolomite comes from Bilaspur.

(*viii*) Cheap labour is available from the nearby areas.

5. Rourkela. Plant of Hindustan Steel Limited at Rourkela is situated in the Sundargarh district of Odisha. It was set up with the help of the then West German firm, Krupps and Demang, during the Second Five Year Plan (West Germany and East Germany have united to form one country now). It became operative in 1959. This plant has the following facilities for its successful operation :

(*i*) This plant uses iron ore obtained from Sundargarh and Keonjhar districts. These iron ore sources are located within a distance of 77 km from the site of the plant.

(*ii*) Coal is obtained from Jharia coalfields located at a distance of 225 km and Talcher, located at a distance of 169 km.

(*iii*) Hydro-electric power is obtained from Hirakud Power Project, located at a distance of 150 km.

(*iv*) The plant receives manganese from Barajmda, dolomite from Baradwar and limestone from Purnapani. These materials are located within a radius of 222 km in Odisha.

(*v*) It is located on the main Nagpur-Kolkata railway line and enjoys facilities of railway transport.

(*vi*) Kolkata provides the port facilities and its hinterland serves as market.

6. Durgapur. This plant of The Hindustan Steel Ltd. is located at Durgapur in Bardhaman district of West Bengal. It was set up in 1959 with the help of the United Kingdom. The production started in 1962. It has a total capacity of 35 lakh tonnes. It produced 12.45 lakh tonnes of crude steel, 10.93 lakh tonnes of saleable steel and 1.14 lakh tonnes of saleable pig iron in 2010-11. The Alloy Steel Plant at Durgapur has a capacity to produce 1.6 lakh tonnes of ingot steel which has been expanded to 2.6 lakh tonnes of crude steel. The following geographical factors favour its location and growth.

(*i*) Iron ore comes from Bolani mines. Mayurbhanj also supplies iron ore. These areas are located within a radius of 320 km.

(*ii*) Coal comes from Jharia and Raniganj.

(*iii*) Limestone is obtained from Birmitrapur in Sundargarh and manganese from Keonjhar district of Odisha.

(*iv*) Dolomite is supplied by Birmitrapur.

(*v*) Hydroelectricity is available from Damodar Valley Corporation.

(*vi*) Plenty of water is available from Durgapur Barrage built across Damodar river.

(*vii*) The Kolkata-Asansol railway line links it with other parts of the country.

(*viii*) Cheap labour is readily available from the surrounding areas.

7. Bokaro. A new public sector company, the Bokaro Steel Ltd. was formed in 1964 to erect a steel plant with the collaboration of the eartwhile Soviet Union at Bokaro near the confluence of the Bokaro and Damodar rivers in Hazaribagh district of Jharkhand. It is the second plant set up with the Soviet help. It started production in 1972. Its initial capacity was 10 lakh tonnes which was raised to 40 lakh tonnes. There are plans to raise its capacity to 100 lakh tonnes making it the largest iron and steel making centre in India. The achievement made by this plant has been made possible due to following few geographical factors :

(*i*) It receives iron ore from Kiriburu mine in Odisha.

(*ii*) Coal is obtained from Jharia coalfields located at a distance of 65 km.

(*iii*) Limestone comes from Palamu district of Jharkhand.

(*iv*) Hydroelectricity is obtained from Damodar Valley Corporation.

(*v*) Kolkata is just 300 km from here and provides port facilities.

Three more steel plants were planned during the Fourth Five-Year Plan in order to meet the growing requirement of steel. These plants are located at Salem in Tamil Nadu, Vishakhapatnam in Andhra Pradesh and Vijayanagar in Karnataka.

8. The Salem Steel Plant. The plant has been set up at Salem in the Salem district of Tamil Nadu. The plant has the advantage of rich iron ore and limestone, which is readily available in the adjoining areas. It also enjoys the facilities of cheap power, charcoal and vast market. The iron ore available here has low sulphur and phosphorus content and is suitable for producing special grade iron and steel.

The plant started commercial production in 1982. Its capacity was 32 thousand tonnes of stainless steel sheets in the beginning. This capacity was doubled in 1991 with the addition of another rolling mill. This capacity was further raised to 80 thousand tonnes of saleable steel in 1995-96. Today the Salem Steel Plant is a major producer of world class stainless steel and is in a position to export stainless steel to some of the advanced countries such as the USA, Mexico, Australia and some countries of South-East Asia. In order to cater to the growing demand for coinage of the Indian Government Mints, the management had also set up a blanking facility in 1993 with a capacity of 3,000 tonnes per annum. It also commissioned a hot rolling facility in November, 1995 which has state-of-the-art technology with high level of automation.

9. Vijayanagar Steel Plant. This plant has been set up at Tornagal near Hospet in Bellary district of Karnataka. It has the installed capacity of 30 lakh tonnes. The production of mild steel is its special feature. This plant enjoys the following facilities :

(*i*) Iron ore is obtained from Hospet region located in close proximity.

(*ii*) Coal comes from Kanhan valley in Chhattisgarh and Singareni coal fields in Andhra Pradesh.

(*iii*) Good quality limestone and dolomite is available at a distance of about 200 km.

(*iv*) Water and power requirements are met by the Tungabhadra hydel project located at a distance of about 36 km from the plant.

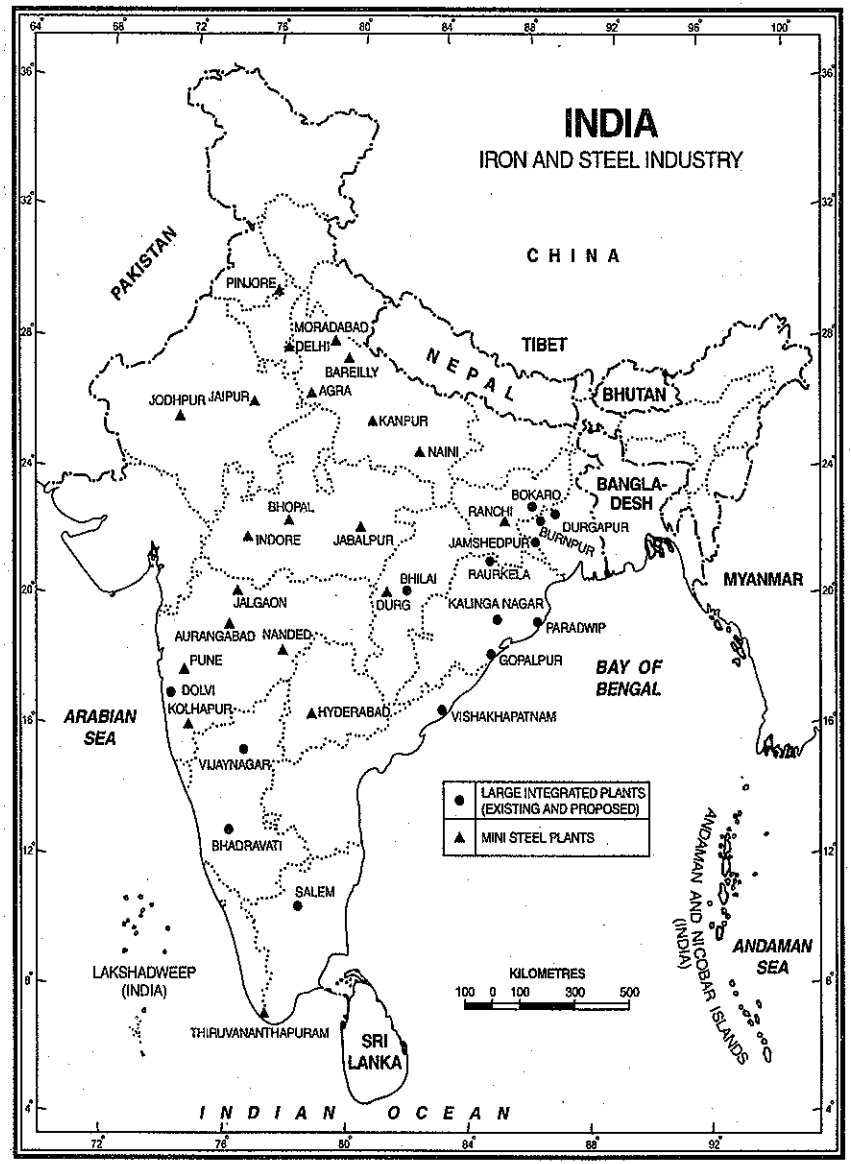


FIG. 25.5. India : Iron and Steel Industry

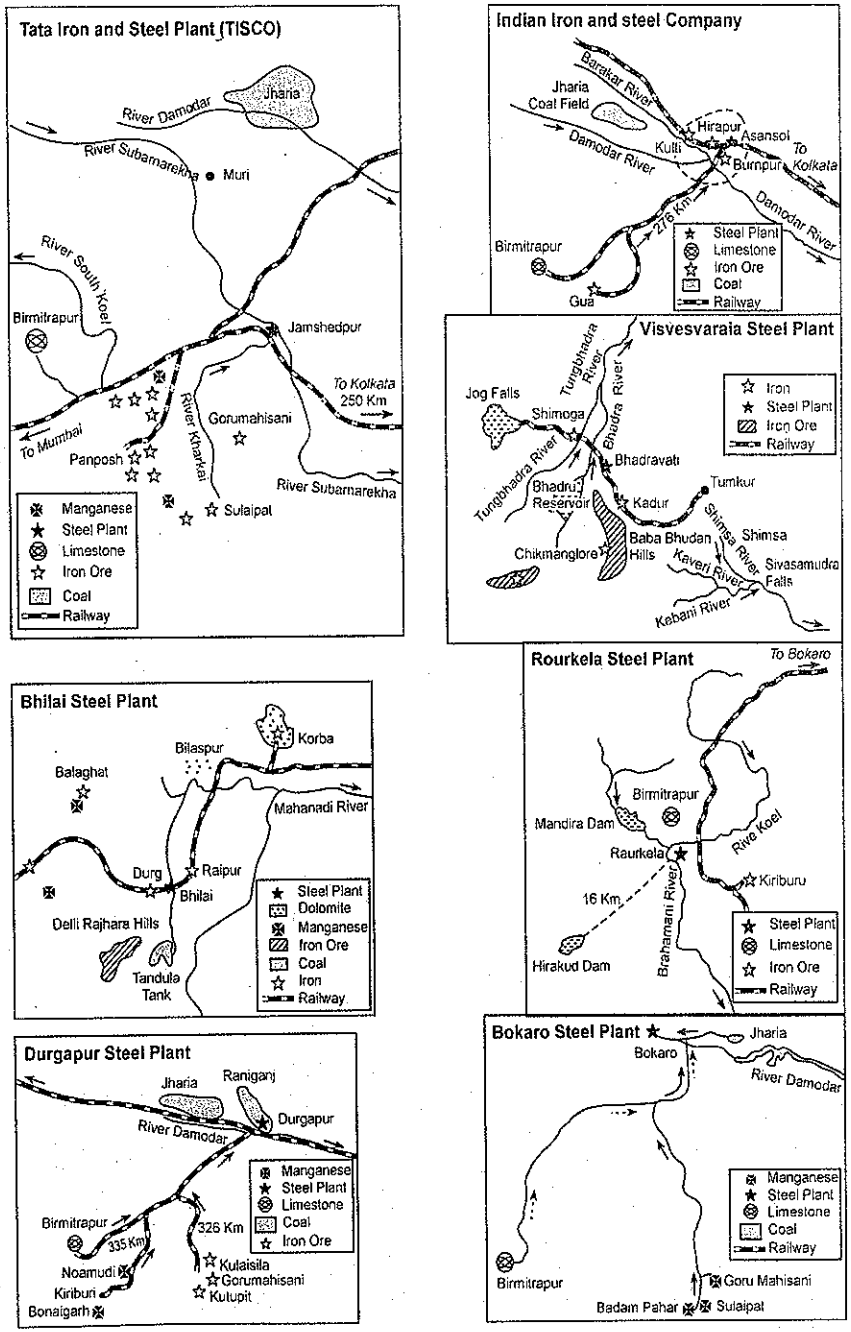


FIG. 25.6. Locational factors of major iron and steel plants in India.

Another steel plant at *Paradwip* is fast coming up.

10. Vishakhapatnam Steel Plant (VSP). This integrated steel plant has a unique location on the sea port. In fact, it is the first shore based steel plant in the country. Although the foundation stone of the plant was laid in 1972, the construction work could not start in the real sense till February 1982 when *Rashtriya Ispat Nigam Limited* was incorporated as a public sector company to implement the construction of the plant.

The project has been completed in two stages : the first stage was completed by March 1992 and the second and final stage by July 1992. This is the most sophisticated modern integrated steel plant in the country. Though the production commenced in 1991-92, 1993-94 was the first full year of integrated operation. It is a major export oriented steel plant and takes full advantage of its coastal location. Currently holding 67th rank among 80 largest steel makers on the globe, as certified by the Brussels-based International Iron and Steel Institute, VSP is smooth-sailing towards reaching its goal of turning into a 'world class company in steel industry'; as a result of the effective turn around strategy adopted by its management for the last couple of years. Buoyed by such a strong performance the VSP now intends to accelerate on the expansion trajectory. Presently it is the second largest producer of iron and steel in the country and the present annual capacity of ten million tonnes of liquid steel can be raised. The plant management intends to go in for massive upgradation of technology and skill of its personnel which will be required if the natural gas from the Krishna-Godavari basin is to be utilised to cut down cost. Import of metallurgical coal from Australia can be reduced considerably if proper arrangements for utilising natural gas from Krishna-Godavari basin are made. The natural gas requirement is placed at one billion cubic metres (BCM) a year and negotiations are in progress with the Reliance Group in this connection. The plant has the following advantages :

(*i*) The coastal location facilitates import of coal and export of iron and steel.

(*ii*) It is well connected to coal fields of Damodar valley in Jharkhand. Metallurgical coal is imported from Australia which meets about 70 per cent power requirements.

(*iii*) The plant has a bright future with respect to its energy requirements because there are plans to replace coal imported from Australia by natural gas from the Krishna-Godavari basin.

(*iv*) High quality rich iron ore deposits are available in the Bailadila area of Chhattisgarh.

(*v*) Most of the requirements of limestone, dolomite and manganese are met by supplies from Chhattisgarh; Madhya Pradesh and Odisha.

11. Daitari Steel Plant. A decision to set another steel plant at Daitari near Paradwip in Odisha has been taken. Initially, the plant was scheduled to be built by joint venture of British and South Korean companies but its responsibility has been given to the Tata group. The plant is expected to have capacity of producing 2.6 million tonnes of steel per annum.

12. Tata Steel Kalinganagar. Tata Steel will set up a six million plant at Kalinganagar in Odisha with an investment of ₹ 15,000 crore. Land for the project has been acquired and detailed project report has been prepared. The first phase of 3 million tonnes capacity will be completed in three and a half years. Along with this project, Tata Steel is going to build a port at Dharma in Odisha in a joint venture with Larsen & Toubro to handle 3,00,000 tonne ship. A ₹ 1,500 crore investment has been earmarked for the port to facilitate import of coal and export of finished goods.

13. Dolvi Steel Plant. A new steel plant is fast coming up at Dolvi in Ratnagiri district in Maharashtra. Being set up by the Ispat Industries Ltd., the plant will use new technology in steel making. The 3 million tonnes annual capacity hot rolled coil plant will be one of the most modern plants in the world. It will require less space, less energy, high labour productivity and will involve less cost of production. Producing thin strips will be a special quality of this plant.

Posco Steel, Paradwip. Pohang Steel Company (Posco) of Korea has entered into a Memorandum of Understand (MoU) with Odisha Government for setting up a steel plant in Jagatsingh disrtrict of Odisha with a total investment of ₹ 51,000 crore. The project with a capacity of 12 million tonnes per annum was scheduled to be completed by 2016. But difficulties with respect to land acquisition is a big problem because the farmers are not willing to part with their land. Pasco needs 4,004 acres of land. It is billed as the biggest foreign direct investment (FDI) in Indian history. A huge quantity of 600 million tonnes of iron ore will be made available for manufacturing iron and steel.

Mini Steel Plants. In addition to the integrated steel plants, a large number of decentralised secondary units produce steel by using steel scrap/sponge iron as raw material and electric arc furnace and induction furnace for processing. With capacity varying from ten thousand to five lakh tonnes, these are known as mini steel plants. It is easy to construct such plants and their gestation period is short. While integrated steel plants mainly produce mild steel in bulk, the mini steel plants produce mild steel as well as alloy steel including stainless steel. Most of the mini steel plants are located in areas far away from the integrated steel plants so that they can meet the local demands there (*see* **Fig. 25.5**). Currently, about 200 units with an installed capacity of 12 million tonnes have been commissioned and have started commercial production. Other units are at various stages of implementation. This sector experienced rapid growth in 1970s but remained more or less stagnant in 1980s. The new Industrial Policy announced in July 1991 has removed iron and steel from the list of industries reserved for the public sector and also exempted it from the requirements of compulsory licensing. According to the provisions of this policy, no industrial licence is required for the establishment of iron and steel plants of any capacity in the private sector, except for locations within 25 km of the city with a population of 10 lakh as per the 1991 census. Entrepreneurs are, therefore, free to set up steel plants of any capacity, subject to locational restrictions.

International Trade. India is both an importer and an exporter of iron and steel as is clear from the following brief description. However, our imports are much higher than the exports.

Imports. Production of iron and steel in the country falls short of our demands and India has to spend crores of rupees to import various items.

A look at Table 25.11 reveals that imports of iron and steel by India have shown varying trends. The production picked up quickly in the second Five Year Plan. Due to spurt in production and slackness in demand, the industry faced problem of stockpiles for a short duration from 1974 to 1977 and even exported some steel. But this boom could not survive for long time and soon the surplus was replaced by shortages, resulting in heavy imports. The imports touched an all time high of 10,974.6 thousand tonnes in 2012-13 but cost of imports was highest as ₹ 74,063 crore in 2013-14. Although India is the fourth largest producer of steel in the world, her per capita consumption of 20 kg is much below the world average of 143 kg and way behind 420 kg in Russia, 422 kg in Britain, 620 kg in Japan, 700 kg in the USA and 734 kg in Sweden. A modest increase of upto 40 kg per capita in demand for steel would raise the total demand upto 40 million tonnes forcing the country to resort to huge imports of steel and its products.

Some quantity of steel is always needed to be imported, specially those grades and qualities which are required in small quantities and do not justify setting up of production capacities. Typical items of imports are rolled coils, cold rolled coils, semis and steel scrap.

Exports. Value addition in the Indian export basket has been a major trend with exports mainly consisting of hot rolled coils, cold rolled coils, colour coated sheets, galvanised plain (GP) sheets, galvanised corrugated (GC) sheets, and pig iron. Export of total finished steel (non-alloy and alloy) during 2012-13 (provisional) was 5.285 metric tonnes compared to 4.59 metric tonnes in 2011-12 registering a growth of 14.5 per cent.

TABLE 25.11. Imports of Iron and Steel

	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity in thousand tonnes	1325.2	683.4	2,031.1	920.5	1,613.6	9,843.9	10,601.9	10,974.6	10,954
Value in ₹ crore	123	147	852	2,113	3,569	47,275	57,552	59,582	74,063

Source : The Economic Survey 2013-14, Statistical Appendix pp. 71-73.

Problems of Indian Iron and Steel Industry

1. Capital. Iron and steel industry requires huge capital investment which a developing country like India cannot afford. Many of the public sector integrated steel plants have been established with the help of foreign aid.

2. **Lack of Technology.** Throughout the 1960s and upto the oil crisis in mid-1970s, Indian steel industry was characterised by a high degree of technological efficiency. This technology was mainly from abroad. But during the following two decades after the oil crisis, steep hike in energy costs and escalation of costs of other inputs, reduced the margin of profit of the steel plants. This resulted in lower levels of investment in technological developments. Consequently, the industry lost its technology edge and is now way behind the advanced countries in this regard. Material value productivity in India is still very low. In Japan and Korea, less than 1.1 tonnes (and in several developed countries 1.05 tonnes) of crude steel is required to produce a tonne of saleable steel. In India, the average is still high at 1.2 tonnes. Only about ₹ 200 crore is invested in R & D activities which is hardly 0.15 to 0.25 per cent of the sales turnover. Improvement in the yield at each stage of production, particularly for value added products will be more important in the coming years.

3. Low Productivity. The per capita labour productivity in India is at 90-100 tonnes which is one of the lowest in the world. The labour productivity in Japan, Korea and some other major steel producing countries is about 600-700 tonnes per man per year. At Gallatin Steel a mini mill in the U.S. there are less than 300 employees to produce 1.2 million tonnes of hot rolled coils. A comparable facility in India employs 5,000 workers. Therefore, there is an urgent need to increase the productivity which requires retraining and redevelopment of the labour force.

4. Inefficiency of public sector units. Most of the public sector units are plagued by inefficiency caused by heavy investment on social overheads, poor labour relations, inefficient management, under-utilisation of capacity, etc. This hinders proper functioning of the steel plants and results in heavy losses.

5. Low potential utilisation. The potential utilisation in iron and steel is very low. Rarely the potential utilisation exceeds 80 per cent. For example, Durgapur steel plant utilises only 50 per cent of its potential. This is caused by several factors, like strikes, lockouts, scarcity of raw materials, energy crisis, inefficient administration, etc.

6. Heavy demand. Even at low per capita consumption rate, demand for iron and steel is increasing with each passing day and large quantities of iron and steel are to be imported for meeting the demands. Production has to be increased to save precious foreign exchange.

7. Shortage of metallurgical coal. Although India has huge deposits of high grade iron ore, her coal reserves, especially high grade coking coal for smelting iron are limited. Many steel plants are forced to import metallurgical coal. For example, steel plant at Vishakhapatnam has to import coal from Australia. Serious thought is now being given to replace imported coal by natural gas from Krishna-Godavari basin in this plant.

8. Inferior quality of products. Lack of modern technological and capital inputs and weak infrastructural facilities leads to a process of steel making which is more time consuming, expensive and yields inferior quality of goods. Such a situation forces us to import better quality steel from abroad. Thus there is urgent need to improve the situation and take the country out of desperate position.

ALUMINIUM SMELTING

Aluminium smelting is the second important metallurgical industry of India, next only to iron and steel industry. It plays a crucial role in the overall industrial development of the country. Its elasticity, flexibility, good conductivity of electricity and heat, and its capacity to be modulated into any desired shape has made aluminium a universally accepted metal. It is widely used in a large number of industries including generation and distribution of electricity, manufacturing of aeroplanes, railway coaches and bus bodies, building and architectural activities, defence and nuclear accessories, household utensils, packaging and for making coins. It is gaining popularity as a substitute to several other metals like steel, copper, zinc, lead, etc. in a large number of industries. The sectoral consumption of alluminium is given in **Table 25.12**. This table shows

that consumption in India differs widely from the world average consumption.

TABLE 25.12. Sectoral Consumption of Aluminium in 2003 (percentage share)

Sector	World	India
Electrical & Electronics	9	32
Transportation	31	18
Construction	18	16
Packaging	17	12
Consumer Durables	6	6
Industrial Machinery	9	4
Powders & Chemicals	—	6
Others	10	6
Total	**100**	**100**

Source : The Hindu Survey of Indian Industry, 2004, p. 197.

The per capita consumption of aluminium in India is barely 500 gram against 5.9 kilogram in the U.S. and 3.6 kilogram in Brazil.

Localisation

The production of one tonne of aluminium requires approximately 6 tonnes of bauxite, 0.26 tonnes of caustic soda, 0.09 tonnes of lime, small quantity of cryolite, aluminium flouride, calcium flouride, anthracite (calcined) and soda ash and 18,573 kWh of electricity. About 30-40 per cent of the production cost of aluminium is accounted for by electricity alone. This clearly indicates that the availability of bauxite and electricity are the two most significant factors which influence the localisation of this industry. Odisha and Gujarat are the major producers of bauxite in India.

Growth and Development

Manufacturing of aluminium metal commenced in 1886 and fabrication of utensils from imported metal started in 1929. Indian Aluminium Company started its production in 1938. Production of virgin aluminium from the indigenous bauxite ore made good progress during World War II. In fact, modern aluminium manufacturing is a war-born industry. The credit for this phenomenal growth goes to the Aluminium Corporation of India Ltd. It was formed in 1937 as a public limited company and its plant at Jaykaynagar in West Bengal started production of alumina in 1942 and that of aluminium in 1944. The Indian Aluminium Company Ltd. (INDAL) started fabrication of sheets from imported alumina in 1943 and production of alumina from indigenous bauxite in 1948. Its plant was set up at Alupuram in Kerala. These were the only two companies producing aluminium in the country till 1960. During the Second Five Year Plan, the demand for aluminium increased and two more plants at Hirakud in Odisha and Renukut in Uttar Pradesh were established by Indian Aluminium Company Ltd. (INDAL) and Hindustan Aluminium Corporation (HINDALCO) respectively.

Public sector has also contributed to the growth of aluminium industry. The Bharat Aluminium Company Ltd. (BALCO) came into being in 1965. Its first plant with a capacity of one lakh tonnes was set up at Korba in Chhattisgarh. It started production of alumina in 1973 and aluminium in 1975. The second plant by this company was established at Ratnagiri in Maharasthra. This plant has a capacity of 50,000 tonnes. Madras Aluminium Company Ltd. (MALCO) went into operation in 1965. Its plant is situated at Mettur. The National Aluminium Company Ltd. (NALCO) came into being in 1981. It has set up an integrated aluminium plant at Damanjodi near Jeypur in Koraput district of Odisha. This is the largest complex in India. The smelter with a capacity of about 2,18,000 tonnes a year has been set up at Angul in Dhenkanal district. Commercial production of aluminium started in 1988-89. As a result of expansion, the bauxite mining capacity of NALCO has doubled to 48 lakh tonnes a year and the alumina refinery at Damanjodi nearly doubled to 15.75 lakh tonnes. The new expansion plan has led to raising of the bauxite mining capacity to 63 lakh tonnes, alumina to 21 lakh tonnes, aluminium to 4.6 lakh tonnes and captive power generation to 1,200 MW. NALCO, the lowest cost producer of aluminium in the world, at present ranked among the top 10 global companies and is second to HINDALCO in India.

The Indian aluminium industry has taken giant strides following its decontrol in 1989 and launch of the economic liberalisation programme in 1991. Production has grown, cost efficiency is proven and the industry has abundant resources of bauxite, a sizable pool of experienced manpower and its proven competence in alumina and aluminium smelting to accelerate its growth.

TABLE 25.13. Production of Aluminium (Virgin Metal) in India

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Production in thousand tonnes	4.0	18.5	168.8	199.0	451.1	620.4	831.7	1,061.2	1,042.7	934.5	1,045.1	790.4	963.2

Source : Economic Survey 2012-13, p. A-31.

The progress of aluminium industry was slow during the first three five-year plans but picked up later on till it reached first maxima of a record production of 1,061.2 thousand tonnes in 2006-07. After this, the production declined primarily due to power shortages and interruptions in the supply of bauxite.

Imports. Earlier, India was almost self-sufficient with respect to supplies of aluminium. But the demand for aluminium has increased considerably in the past few years due to rapid progress in different spheres of economic activity. As such, India has started importing aluminium in a big way.

COPPER SMELTING

Though copper has been used for various purposes since time immemorial, the development of copper smelting industry took place only recently. Earlier, efforts to smelt copper proved abortive. Indian Copper Corporation was set up in 1924 and a plant was set up at Ghatsila in Singhbhum district of Jharkhand. The Hindustan Copper Ltd. came into being in 1967. It took over Indian Copper Corporation in 1972. Since then the Hindustan Copper Ltd. is the sole producer of copper in the country.

At present, copper is produced at only two centres. One is located at Maubhandar near Ghatshila in Singhbhum district (Jharkhand) and the other at Khetri in Jhunjhunu district (Rajasthan). The smelter at Maubhandar (Ghatshila) receives copper ore from Mosabani, Rakha, Dhobani Rajdah, Tamapahar and Turamdih. All these areas are located in Singhbhum district. It was the only producer of copper till 1971 and it produced about 9.3 thousand tonnes of copper annually. The smelting unit has been replaced by blister copper unit with a capacity of about thirty thousand tonnes. HCL plans to double its capacity at a marginal cost.

The Khetri Copper Complex at Khetri has been erected by Hindustan Copper Ltd. It is an integrated copper mining-cum-metallurgical plant. The smelter was commissioned for large scale production of electrolytic copper in 1974. It receives copper ore from Khetri, Kolihan (5 km south of Khetri), Chandmari (8 km south of Khetri) and Dariba in Alwar district about 150 km away. The copper smelter at Khetri has an installed capacity of 31,000 tonnes of copper metal per year. HCL plans to expand its capacity from 31,000 tonnes per annum to one lakh tonnes per annum at an estimated cost of ₹ 560 crore. The plant also has a production capacity of 2 lakh tonnes of super phosphates and 1.82 lakh tonnes of sulphuric acid per annum. The Malanjkhand mines in Balaghat district of Madhya Pradesh supplement the supply of copper ore to Khetri. For treatment of Malanjkhand concentrates the capacity of smelter and refinery plants at Khetri have been increased to 45,000 tonnes per annum. Agnigundala Copper-Lead project in Guntur district of Andhra Pradesh has started production.

Sterile Industries is a private sector company which uses imported copper concentrates to produce cathodes. Its smelting plant was commissioned at Tuticorin (Tamil Nadu) in 1997-98. The initial capacity of this plant was 60,000 tonnes which was raised to about 1.5 lakh tonnes in 2000-01. During 1997-98, this plant produced 21,000 tonnes of anodes (unrefined copper).

Birla Copper Ltd. is a division of Indo-Gulf Fertilisers which has set-up a copper project at Dahej in Gujarat at an estimated cost of ₹ 1,850 crore. Its initial capacity was 1 lakh tonnes which was raised to 1.5 lakh tonnes later on. The smelter is based on imported copper concentrates.

Swil Copper Ltd. has set up a plant at Bharuch in Gujarat under the technical assistance from Boliden of Sweden. The plant has an annual capacity of 50,000 tonnes and is based on copper scrap. Most of the copper scrap is received from the USA, African countries and the Asia Pacific Region.

Production of copper in India increased substantially after 1970-71 when Khetri Copper

TABLE 25.14. Production of Blister Copper (Virgin Metal)

Year	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Production in thousand tonnes	764.1	797.5	889.6	853.8	705.4	670.6	684.6

Source : Economic Survey, 2012-13, p. A-31.

Complex in Rajasthan became operative. Production of copper and copper products researched an all time high of 853.8 thousand tonnes in 2008-09 after which declining trends in production have been observed which is primarily due to low rate of productivity of our copper smelting plants. The red metal's usage is regarded as a reliable indicator of economic growth in the industrial community as it has a variety of sophisticated applications. However, the consumption rate is likely to increase with the overall industrial growth in the country. The surge in demand has attracted investments from the private sector.

Imports. Presently, India produces only half of her requirements of copper and the remaining half is imported. The main suppliers of copper to India are Zambia, Zaire, Chile, the USA, Canada and some West European countries.

LEAD AND ZINC SMELTING

Lead

The first lead smelting plant was set up at Tundoo near Dhanbad (Jharkhand) in 1942-43 by a private company named as the Metal Corporation of India. The commercial production by this plant commenced in 1945. It was taken over by Hindustan Zinc Ltd. (HZL), a public sector enterprise in 1965. The supply of lead cocnentrates is obtained from the Zawar and Rajpur-Dariba areas of Rajasthan. The plant has an installed capacity of 8,740 tonnes per day. The HZL has set up another plant at Vishakhapatnam. It is primarily based upon the imported lead concentrates although some ore is obtained from Agnigundala also. Its installed capacity is 22,000 tonnes per annum. The lead-zinc complex at Chanderiya was constructed in 1991 under the British aid programme. It has an annual capacity of 35,000 tonnes of lead.

Indian Lead Ltd. (ILL) is a new plant with a rated capacity of 24,000 tonnes of lead per annum. The plant is based on lead scrap and concentrates.

The production of lead (virgin metal) was only 873 tonnes in 1951. It increased to 3,665 tonnes in 1961, and fell to 1,709 tonnes in 1971-72. It again jumped to 14,462 tonnes in 1981-82. Further it fell from 62,899 tonnes in 1999-2000 to 59,132 tonnes in 2012-13.

Imports. Production of lead always falls short of demand and large quantities of lead have to be imported every year to meet the growing demand.

Zinc

At present, there are four zinc smelters in the country, one each at Alwaye (Kerala), Debari and Chanderia (Rajasthan) and Vishakhapatnam (Andhra Pradesh). The Alwaye plant is wholly dependent upon imported supplies of zinc concentrates. It started production in 1967 and has an installed capacity of about fifty thousand tonnes per annum. It plans to raise its production from 20,000 to 30,000 tonnes. The Debari plant started production in 1968. It has installed capacity of smelting 18,000 tonnes of zinc annually which is being raised to 45,000 tonnes. Besides, it also produces 87,000 tonnes per annum of sulphuric acid, 190 tonnes of cadmium, 26,000 tonnes of phosphoric acid and 72,000 tonnes of high super phosphate annually. The ore is supplied by Balaria and Rajpur-Dariba mines. However, the supplies of ore from these mines are not sufficient and half of the zinc concentrates have to be imported. The Chanderia smelting plant was set up in 1991. It is based upon the supplies of ore from Bhilwara and Chittaurgarh. It is an HZL enterprise and has an annual capacity to produce 70,000 tonnes of zinc, 35,000 tonnes of lead and 74 tonnes of silver. Vishakhapatnam produces over 2.8 thousand tonnes of zinc. This plant has an installed capacity of 30,000 tonnes which is being increased to 40,000 tonnes per annum. The plant receives zinc ore from Agnigundala mines. These mines were earlier owned by the Hindustan Copper Ltd.

The production of zinc in India started after 1967. The total production was 20,800 tonnes in 1973

which increased to 45,500 tonnes in 1980-81 and 1,70,000 tonnes in 1996-97. At present the total production of zinc in India is over two lakh tonnes.

With the expansion of industries, the demand for zinc is rapidly increasing. Keeping the present trends in mind, it is estimated that the demand for zinc will increase to over six lakh tonnes in 2020 from the present level of about three lakh tonnes. India can meet about 90 per cent of her demands if proper care is taken to augment the smelting capacity and

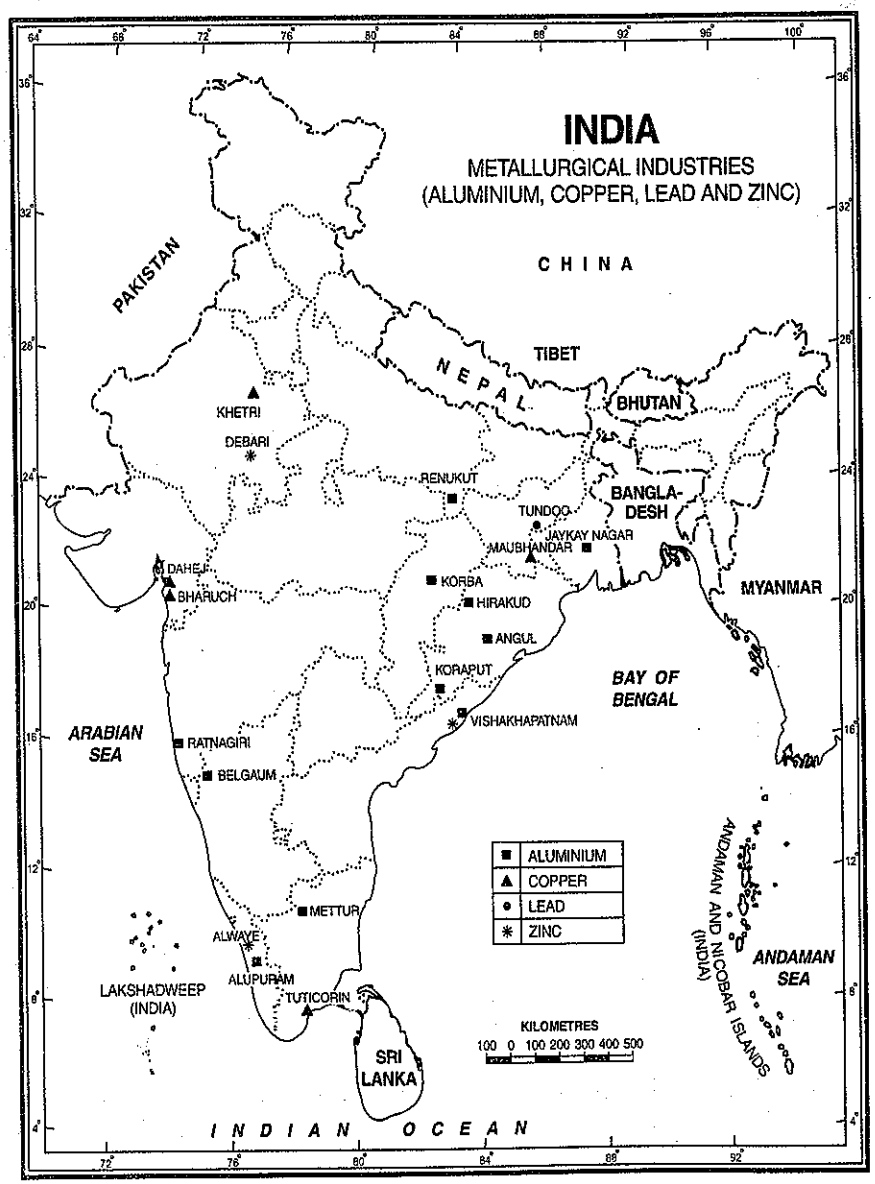


FIG. 25.7. India : Metallurgical Industries (Aluminium, Copper, Lead and Zinc)

increase production. However, India has resorted to imports of zinc to meet the growing demand for the commodity.

ENGINEERING INDUSTRIES

Engineering industries cover a wide range of industries and contribute substantially to the manufacturing of industrial machines, machine tools, transport, transmission and telecommunication equipments, building and construction, public health and sanitation and modern sophisticated goods. These industries need a large number of components which they do not produce themselves. Therefore, they have stimulated a large number of ancillary industries which depend upon the main engineering units. The products of the engineering industries cover a wide range varying from pins, screws, nuts and bolts through light and heavy machinery to ships, aircrafts, automobiles, rail coaches, air conditioners and computers, etc. Thus engineering industries are labour intensive and capital demanding and are located mainly in those areas where these major components are available. At present, engineering industries account for about one-third of the production capital in the organised sector, one-third of the value of output and nearly 30 per cent of the employment is in the public sector. Further, these industries contribute about 10 per cent of the total exports of the country.

Heavy Machinery

Manufacturing of heavy machinery made a beginning in 1958 when Heavy Engineering Corporation Ltd. was set up at Ranchi in Jharkhand. It has an installed capacity of 80,000 tonnes of heavy machinery and 25,000 tonnes of structures per annum. The plants produce castings, forgings and rolls to meet the requirements of heavy machine tools and heavy machine building plants. The Mining and Allied Machinery Corporation Ltd., Durgapur produces various items of mining equipment.

Structurals. Structurals include a wide range of items ranging from simple structures like ordinary warehouse building to sophisticated items such as railway bridges, steel plant buildings, etc. At present, there are over 130 factories engaged in fabrication of structural items with a total capacity of about 7 lakh tonnes. The Tungabhadra Steel Products Ltd. at Tungabhadra dam in Karnataka was set up in 1947. It manufactures structurals including gates and hoists, transmission towers and penstock pipes. The Triveni Structurals Ltd., a public sector enterprise, was set up in 1965 at Naini (Allahabad). It is a joint venture of Govt. of India and M/s. VOEST of Austria and manufactures complex steel structures such as building structures, crane construction, power transmission towers, pressure vessels, plate work, etc. The Bharat Heavy Plate and Vessels Ltd., established in 1966 at Vishakhapatnam, manufactures heavy plates and vessel equipment required by the fertilizer, petrochemical and other heavy chemical industries. Heavy plates are used in the construction of distillation column tanks and various types of vessels. It has a capacity of 23,000 tonnes per annum. A steel structural fabricating shop was set up at Ranchi (Jharkhand) in 1968. It has three units *viz.*, Heavy Machine Building Plant, Foundry Forge Plant and Heavy Machine Tools Plant. These plants produce castings, forgings and rolls to meet the requirements of heavy machine tools and heavy machine building plants. Another plant to manufacture high pressure boilers and boiler fittings has been set up at Tiruchchirappalli. Messrs Jessop and Co. Ltd. Kolkata, and Richardson & Cruddas Ltd., Mumbai produce machinery and heavy structurals. M/s. Larsen & Tubro Ltd., at Powai (Mumbai) produce machinery, heavy equipment for steel, under carriage parts, chemical, petro-chemical and cement industries. Drills for drilling holes in rocky areas are manufactured at Naroda near Ahmedabad.

Heavy machinery and structural industry has made much progress after Independence and the country is now in a position to export several items which were earlier imported from the western countries.

INDUSTRIAL MACHIENRY MANUFACTURING

India today produces a wide spectrum of industrial machinery including textile, cement, sugar, paper, chemical, mining, agricultural machinery, pharmaceuticals, fertilizer, dairy, metallurgical, leather and food processing industries. These industries got a good start during the Second World War but the real progress has been achieved during the plans period.

(*i*) **Textile Machinery.** India is an important producer of textile machinery. The country is in a position to export textile machinery after meeting the demand of the domestic market. Asian and African countries are the main buyers. Textile machinery manufacturing commenced with the Textile Machinery Corporation Ltd. (TEXMACO) at Mumbai in 1939. Later on, units were also started at Kolkata, Coimbatore, Ahmedabad, Ludhiana and Gwalior. The products include cording engines, ring frames, draw frames, fly frames, speed frames, sizing frames, open width bleaching plant, hot air stentors,

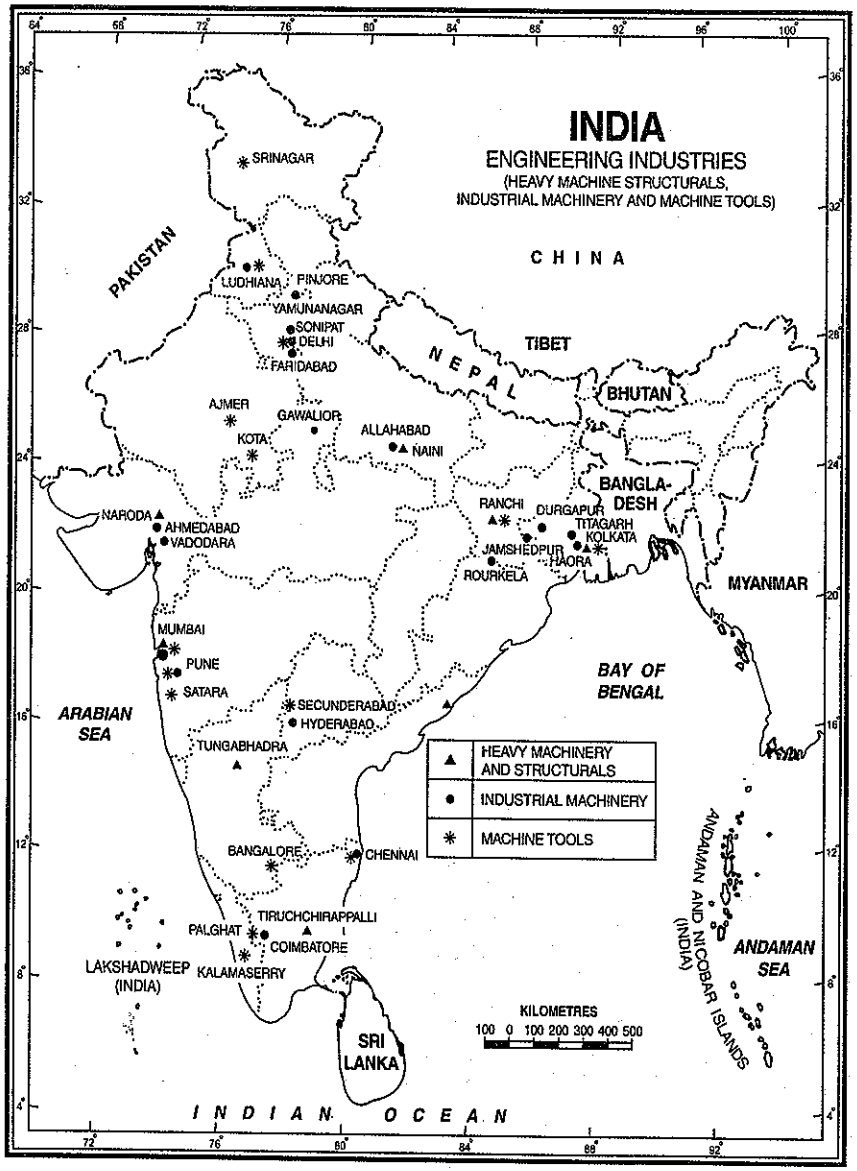


FIG. 25.8. India : Engineering Industries (Heavy machine, structurals, industrial machinery and machine tools)

mercerisers, polymerisers. The industry comprises over 1,446 machinery and components manufacturing with over 600 units producing complete machinery and other units mainly into the production of parts and accessories of textile machinery. In 2011-12, textile machinery worth ₹ 29,785 crores was produced. To encourage the textile industry, the industry is de-licenced and FDI upto 100 per cent under automatic route as well as technology collaboration is allowed freely.

(*ii*) **Jute Mill Machinery.** Currently 63 units are engaged in manufacturing jute mill machinery. Majority of them are concentrated in the Kolkata-Haora region.

(*iii*) **Sugar Mill Machinery.** The main centres of sugar mill machinery are at Kolkata, Chennai, Mumbai, Allahabad, Pimpri and Yamunanagar. About 12 units are engaged in manufacturing sugar mill machinery.

(*iv*) **Cement Mill Machinery.** There are 13 units engaged in manufacturing cement mill machinery. These units are largely located in Tamil Nadu, West Bengal, Odisha and Karnataka. The main centres are Mumbai, Chennai, Pune, Delhi, Shahibabad and Durgapur.

(*v*) **Paper Mill Machinery.** This machinery is manufactured by nearly 20 firms. These are spread over in West Bengal, Maharashtra, Jharkhand, Punjab and Odisha. The main centres are Titagarh, Jamshedpur and Rourkela.

(*vi*) **Chemical and Pharmaceutical Machinery.** There are about 70 projects engaged in the manufacture of chemical and pharmaceutical mill machinery manufacturing a wide range of machinery such as sulphuric acid plant, superphosphate plants, water treatment plant, solvent extraction plants, heat exchangers, pressure vessels, crystallizers, evaporators and a host of other machines.

(*vii*) **Agricultural Machinery.** Agricultural machinery covers a wide range of production including earth moving machinery, excavators, bulldozers, power tillers, steel discs, threshers, harvestors, cutters, tractors and many more implements and machines. Faridabad, Kolkata, Chennai, Vadodara, Hyderabad, Dehagaon and Sonepat are the main centres of producing agricultural machinery.

(*viii*) **Coal Mining and Washery Machinery.** The Coal Mining Machinery Project at Durgapur produces grinding mills, rotary fans, rotary kilns, power shovels, coal cutters, loaders, conveyors, haulages, electrical winders, booster fans, axial fans, automatic cape keeps, safety hooks, shutter cars and mine locomotives. Drilling rigs and other equipments for oil exploration are also produced here. Kolkata and Jamshedpur are the other important producers. Other machines, such as power driven pumps, diesel engines, building and construction machinery, weighing machinery, dairy machinery, oil mill machinery, rubber machinery, etc. are also produced in India.

MACHINE TOOLS

The machine tool industry is the core industry and forms the basis of developing engineering industry. The manufacturing of machine tools commenced in 1930s. Kirloskar Brothers Ltd. is the pioneer company in this regard. The industry got an impetus during the Second World War but rapid progress has been made during the plan period.

The Hindustan Machine Tools (H.M.T.) is the first large scale modern machine tool factory set up in public sector at Bangalore in 1953, with Swiss collaboration. It is a multi-unit, multi-product company which is the largest manufacturer of machine tools in the country. It is a leading player in the machine tool industry and produces a wide variety of machine tools, wrist watches, tractors, printing machinery, high precision lathes, radial drilling machines, grinding machines, gears, shapers, gear hobbing machines, die castings, lamp making machinery, lamp and lamp components, etc. Two units of the company are located at Bangalore and the others are at Pinjore (Haryana), Kalamassery (Kerala), Hyderabad, Srinagar and Ajmer. Its watch factories at Bangalore and Srinagar manufacture several varieties of ladies and gents watches and automatic date watches. The annual production is about four lakh watches.

Besides H.M.T., there are other public and private companies which produce different types of machine and hand tools. ***The Heavy Machine Tools Plant*** at Ranchi started production in 1966. It was set up with Czech assistance. With a capacity of 10,000 tonnes, it produces axle turning, radial drilling

machines, burnishing lathes, wheel lathes, central lathes, double column planing machines, etc. It also produces special machine tools for the railways. ***The Praga Tools Ltd.,*** another public sector enterprise at Secunderabad is mainly meant for defence equipment and stores. It also produces machine tools and accessories, precision tools, auto and diesel parts and railway components. ***The National Instruments Factory at Kolkata*** along with its Jadavpur unit produces precision instruments such as drawing instruments, office equipment, survey instruments, microscopes, binoculars, optical and vision sighting equipment and blood pressure equipment. ***The Instrumentation Ltd.*** has set up a precision plant at Kota and mechanical instruments plant at Palghat (Kerala). The Kota plant manufactures magnetic, electromagnetic and electronic instruments. The Palghat plant produces hydraulic and pneumatic instruments.

Currently there are around 200 machine tool manufacturers in the organized sector as also around 400 small scale units. They are dispersed all over the country with greater concentration at Mumbai, Kolkata, Delhi, Bangalore, Chennai, Thane, Pune, Coimbatore, Satara, Ludhiana and Amritsar. Today 65 per cent of machine tool requirement in India is met by indigenous manufacturers. The industry lacks in design and engineering capability to undertake high procision machines. Due to technology gap in the field of metal cutting machine tools, metal forming technology as well as research and development initiatives are encouraged to bridge the gaps. The industry is delicenced and FDI upto 100 per cent under automatic route as well as technology collaboration is allowed freely.

TRANSPORT EQUIPMENT INDUSTRY

This is vast and varied type of engineering industry which includes railway equipment (locomotives, coaches and wagons), auto-vehicles (trucks, buses, cars, three wheelers, two wheelers, shipbuilding, aircraft, and cycle manufacturing.)

RAILWAY EQUIPMENT

The manufacturing of railway equipment has made rapid strides since Independence. India today is not only self-sufficient with regard to production of railway equipment but is in a position to export substantial quantities of rails, locomotives, coaches, wagons, signalling equipment, etc. Rolling stock comprising the locomotives, coaches and wagons constitute the bulk of production.

LOCOMOTIVES

In the pre-Independence era, steam locomotives were assembled and partly manufactured at Ajmer in the B.B.&C.I. Railway workshop and at Kanchanpara in the workshops of Bengal-Assam Railway. Later on, three units started producing locomotives. They are : (*i*) Chittaranjan Locomotive Works, Chittaranjan (*ii*) The Diesel Locomotive Works at Varanasi and (*iii*) Tata Engineering and Locomotive Co., Jamshedpur.

The Chittaranjan Locomotive Works (CLW) at Chittaranjan has been set up in Burdwan district of West Bengal. It obtains iron from Asansol and Durgapur which are respectively 25 km and 67 km away from Chittaranjan. Raniganj Coalfields are also nearby. Hydroelectricity comes from DVC. Production started in 1950 and this locomotive works produced 2,351 steam locomotives till Dec., 1972. Since then, the production of steam locomotives has been discontinued and their place has been given to electric locomotives. In fact, the production of electric locomotives started in 1961 itself and since then their production has been increasing. There is no likelihood of resuming the production of steam locomotives because they use coal and emit huge quantity of smoke, thereby polluting the environment. Moreover, steam locomotives have less traction power and energy for a quick acceleration than that of electric or diesel locomotives.

The Diesel Locomotive Works at Varanasi started assembling locomotives from imported components in 1964. Its initial capacity was 150 broad gauge diesel locos per year. The first loco rolled out of the assembly lines in 1964 itself.

The Tata Engineering and Locomotive Works (TELCO) is a private sector unit and is located at Jamshedpur. It was set up in 1951 and it started production of steam locomotives in 1952. However, the production of steam locomotives was stopped in June, 1970 on the termination of company's commitment to the railways. It produced about 1200 steam locos during this period.

Bharat Heavy Electricals Limited (BHEL), **Bhopal** has developed capability to manufacture electric locomotives for the Indian railways. Diesel component works has been set up by the railways at **Patiala** for manufacturing and repairs of components of diesel locos and sub- assemblies.

A Wheel and Axle plant was set up at *Bengaluru* in 1984 to cut down imports in this field. The plant has performed exceedingly well and helped the railways to save valuable foreign exchange.

Other Railway Equipment. Rails and sleeper bars are manufactured in iron and steel works at Bhilai and Jamshedpur and wheels and axles at Durgapur, Jamshedpur and Rourkela. Coaches and wagons are manufactured both in public and private sectors.

COACHES

The Integral Coach Factory at Perambur near Chennai started production of railway coaches with Swiss collaboration in 1955. It now produces almost all types of coaches including air conditioned coaches, electric and diesel rail cars and electrical multiple units. It has an installed capacity of 1,150 coaches per annum.

The Bharat Earth Movers Limited (BEML) at Bengaluru manufactures coaches and electrical multiple units. It has an installed capacity of 400 broad gauge coaches per annum. A Rail Wheel Factory has also been set up at Bengaluru to cut down imports in this field.

Rail Coach Factory at Kapurthala in Punjab was set up in March, 1988. It has an installed capacity of 1000 coaches per annum. It is manufacturing AC 3-Tier coaches in addition to other coaches. Integral coach factory at **Rai Bareli** in Uttar Pradesh has also started functioning.

Some private companies are also manufacturing coaches and wagons. Jessop and Co. Ltd. at Kolkata has an installed capacity of 350 coaches and electrical multiple units. Textile Machinery Corporation (TEXMACO), Kolkata, Braithwaite Co. (India) Ltd., Kolkata, Burn and Co., Kolkata are some other companies which produce railway coaches.

WAGONS

Wagon manufacturing industry is fully geared to meet the growing demands of the railways. Most of the wagons are produced in private sector. There are 13 units with an installed capacity of 30,625 wagons (in terms of 4 wheelers) in private sector and three railway workshops with an annual capacity of about 4,000 units. About 60 per cent of wagons are produced in West Bengal and the rest come from Maharashtra, U.P., Punjab and Delhi.

AUTOMOBILE INDUSTRY

Automobile industry globally is one of the largest industries and is a key driver of economy. Owing to its deep linkages with several key segments of industry, automobile industry has a strong multiplier effect on the economy. A well developed Indian automobile industry ably fulfills the catalytic role by producing a wide variety of vehicles such as passenger cars, light, medium and heavy commercial vehicles, multi-utility vehicles, scooters, motor cycles, mopeds, three wheelers, etc.

Automobile industry did not exist in India in the real sense before Independence. Only assembly work was done from the imported parts. General Motors (India) Ltd. started assembling trucks and cars in 1928 in their factory at Mumbai. Ford Motor Co. (India) Ltd. started assembling of cars and trucks at Chennai in 1930 and at Mumbai in 1931. The real development of the industry began with the establishment of the Premier Automobiles Ltd. at Kurla (Mumbai) in 1947 and the Hindustan Motors Ltd. at Uttarpara (Kolkata) in 1948. Automobile industry in India has made considerable progress during the last three decades. Today, it is one of the most vibrant sectors of economy.

With gradual liberalisation of the automobile industry since 1991, more and more players have set up manufacturing facilities in India. At present there are 15 manufacturers of passenger cars and multi-utility vehicles, 9 manufacturers of commercial vehicles, 14 of two/three wheelers and 14 of tractors besides 5 manufacturers of engines. This industry currently employs 13.1 million people both directly and indirectly and contributes nearly 6 per cent to the national GDA. The industry is also making a hefty contribution of nearly 20 per cent to kitty of indirect taxes of the government.

Localisation

The automobile industry tends to be located near iron and steel producing centres because steel is the basic raw material used in this industry. The proximity of places producing tyres, tubes, storage batteries, paints and other ancillary industries is considered to be an added advantage. Port cities also find favour with this industry because of the import and export facilities offered by such places. Of late, automobile industry has become market oriented and prefers those locations which offer ready market for the manufactured vehicles. Under the Government plans for decentalization of industries, some locations in remote and industrially backward areas are given priority.

Production and Distribution

The Indian automobile sector is described as the *sun-rise* sector. During the last decade, the sector has been growing at approximately 12-15 per cent per annum. However, in 2008-09 the automobile sector was badly hit due to global economic slow down. But the industry soon recovered from this shock and bounced back on high growth track. Today, India is the seventh largest vehicle manufacturer of automobiles in the world, second largest manufacturer of two wheelers, largest manufacture of tractors and fifth largest manufacturer of commercial vehicles.

Mumbai, Chennai, Jamshedpur, Jabalpur and Kolkata are the chief centres producing automobiles. These centres produce almost all sorts of vehicles including trucks, buses, passenger cars, three wheelers and two wheelers. Motor cycles are also manufactured at Faridabad and Mysore. Scooters are also manufactured at Lucknow, Satara, Akurdi (Near Pune), Panki (near Kanpur) and Odhav (Ahmedabad dist.). Maruti Udyog Ltd. (MUL) at Gurgaon in Haryana started production of passenger cars in 1983. At present there are 38 units engaged in the production of automobiles producing four wheelers, three wheelers and two wheelers.

Commercial Vehicles. Commercial vehicles industry is divided into two broad segments, *viz.*, passenger and goods. The passenger segment is largely controlled by state owned transport undertakings (STUs) while goods vehicles are generally manufactured in private sector. The manufacture of commercial vehicles started in 1950s and the industry registered a rapid growth in the post-liberalisation period as a result of incentives given by the government. The production of commercial vehicles (including buses, trucks, tempos, 3 and 4 wheelers) increased from an insignificant of 8.6 thousand in 1950-51 and to 145.5 thousand in 1990-91 and 910.2 thousand in 2011-12 (**Table 25.15**).

Currently 7 companies are engaged in manufacturing buses and trucks. Tata Engineering and Locomotive Co. Ltd. (TELCO) is the leading producer of medium and heavy commercial vehicles and accounts for over 70 per cent of such vehicles produced in India. Four plants, each at Hyderabad, Pithampur (M.P.), Arson near Rupnagar (Punjab) and Surajpur in U.P. manufacture light commercial vehicles. Premier Automobiles and Mahendra and Mahendra are located in Mumbai, Ashoka Leyland Ltd. and Standard Motor Products of India Ltd. are located in Chennai, Hindustan Motors Ltd. is at Kolkata; and Bajaj Tempo Ltd. is located in Pune.

In addition to the above mentioned manufacturers, Shaktiman trucks are manufactured under the Ministry of Defence and Nissan Jeeps at Jabalpur in collaboration with the Nissan of Japan.

Passenger Cars. A number of companies are engaged in manufacturing passenger cars. Of these, Maruti Udyog Ltd. (MUL) is at the top. It is located at Gurgaon in Haryana. It started production in 1983 with the collaboration of Suzuki Motor Corporation of Japan. Currently this company produces about four-fifths of total cars produced in India. It produces a variety of models of which Zen, Wagon R, Esteem and Gypsy, Swift desire, etc. are very popular. The company has been facing a lot of problems with respect to labour unrest and is trying to shift its manufacturing activities to Gujarat, where congenial atmosphere for industrial investors prevails Hindustan Motors (Kolkata and Chennai), the Premier Automobiles (Mumbai), Standard Motor Products (Chennai), and the Sunrise Industries (Bengaluru) are other important producers. Several new companies have entered the car manufacturing industry of India after liberalization in 1991. These include Hyundai Motors India at Irrungattukottai in Kanchiura district (Tamil Nadu), Daewoo of Korea in 1995 at Surajpur (Uttar Pradesh), Telco at Pimpri (near Pune). Honda of Japan has set up a plant in Uttar Pradesh to

TABLE 25.15. Production of motor vehicles in India (Thousands)

Name	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Commercial vehicles*	8.6	28.2	41.2	71.7	145.5	152.0	391.1	520.0	545.1	416.5	565.6	752.6	910.2
Cars, jeeps and land savers (passenger cars)	7.9	26.6	46.7	49.4	220.8	632.2	1,047.5	1,238.7	1,422.0	1,516.8	1,910.5	2,452.8	2,513.2
Motor Cycles	NA	0.9	97.0	447.2	1,842.8	3,756.1	6,201.2	7,112.2	6,503.5	6,802.0	8,444.9	10,527.1	12,006.9
Tractors (Complete)	N.A.	N.A.	N.A.	71.0	142.2	284.4	236.4	3,060.5	295.0	293.6	373.7	465.4	648.7

*Includes buses, trucks and tempos, 3 and 4 wheelers.

Source : Economic Survey 2012-13, p. A-31.

manufacture 'City'. General Motors has launched Opel Astra. It has tie-up with Hindustan Motors. Ford in collaboration with Mahindra has introduced Ford. Hindustan Motors in collaboration with Mitsubishi of Japan has launched 'Lancer'. Mercedes Benz of Germany in collaboration with Telco is manufacturing E220 and 250D for upper strata of society. Premier Automobiles in collaboration with Fiat-India Auto Limited is manufacturing a number of models.

Table 25.15 shows that car manufacturing industry made rapid progress particularly after Maruti Udyog Limited (MUL) started production in the mid-1980s. The production of passenger cars increased from 220.8 thousands in 1990-91 to 2,513.2 thousands in 2011-12 thereby registering more than ten times increase in a short span of two decades.

Several factors have made it a buoyant industry in the recent past and the industry has a bright future. Reduction in excise duty on passenger cars has led to reduced car prices and created the potential for an increase in demand. This has helped in growth of the industry to a great extent. The government's Auto Policy also has the stated aim of making India an 'Asian hub' for the manufacture of small cars. The small car segment, which refers to the A and B segments, accounts for over 65 per cent of the market. Giving further push to this segment, therefore, adds impetus to a movement that is already underway. For India to become a large manufacturer of small cars, quality and price are the two basic deciding factors.

Introduction of NANO car by the Tata Motors was a big leap forward in popularizing small cars at affordable process to middle class buyers in India It became a big craze in the beginning but lost much of its sheen partly due to some technical problems and partly because of tough competition from other manufacturers of small cars.

The potential for growth is good considering that passenger car penetration in India is a mere 6 car per 1,000 population whereas it is much higher in other developing countries. Even in neighbouring countries like Pakistan and Sri Lanka the penetration is 12 vehicles per 1,000 population. The market is projected to grow at a rate of around 7 per cent annually.

Over the years car sales in A and B segments category as a whole have registered a steady growth because these cars are available in wide range of models and at affordable price. The mid-size category normally pertains to C segment cars. This segment accounts for 15-16 per cent of local car market. In addition to varied models and affordable price, various finance options have also grown with automobile industry. There were times when a car loan meant tedious trips to bank, reams of paper work and long waiting periods for requisite approvals from the sanctioning authority. Today the scenario is quite different, with customers having fast access to very flexible financing options that suit their different needs. Attractive automobile financing schemes have definitely boosted sales of passenger cars. Today, almost 70 per cent of new cars are financed through auto-loans.

Jeeps. Almost the entire production of jeeps comes from Mahindra, Mumbai. It has a capacity to produce about 13,000 jeeps per annum.

Two Wheelers. Two wheeler industry mainly comprises of motor cycles, scooters, mopeds and

scooterettes. The Indian two-wheeler industry made a humble beginning in the early 1950s when Automobile Products of India (API) started manufacturing scooters in the country. Until 1958, API and Enfield were the sole producers. In 1960, Bajaj Auto set up a plant in collaboration with Pioggio of Italy. Two wheeler industry has also made rapid strides. It came a long way from an insignificant production of 0.9 thousand units in 1960-61 to 12,006.9 thousand units in 2011-12 (Table 25.15). The two-wheeler market was opened to foreign competition in the mid-1980s. Practically, all the global giants have been present in India for quite some time. First to come was Suzuki Motor Corporation with TVS in 1984. Honda followed within a year, in a joint venture with Hero Group. Then Kawasaki and Yamaha entered into licence agreement with Bajaj Auto and Escorts respectively. Piaggio has joined up with LML which is planning to expand its capacity to six lakh vehicles per annum. Bajaj Auto is expanding its capacity to two million vehicles per annum. Hero Honda is expanding its Dharuhera plant capacity to over 2,52,000 vehicles a year and has set up a plant at Gurgaon with an investment of ₹ 160 crore. TVS Suzuki plans to invest ₹ 200 crore to expand its production capacity to one million vehicles per annum. Yamaha-Escorts, a joint venture has also announced plans to introduce new range of products and expansion facilities in its Surajpur plant. Mumbai, Pune, New Delhi and Kanpur are main centres of scooter manufacturing. Public sector units are located at Hyderabad, Bengaluru, Satara, Lucknow and Alwar. Motorcycle producing units are located at New Delhi, Chennai, Mysore and Gurgaon.

The dynamics of two-wheeler industry in India makes a fascinating reading. From a semi luxury product for the urban middle class in 1980s and earlier, the two wheeler has now become not only the favourite form of personal transport but also the most coveted personal possession among various consumer classes except perhaps the most affluent. Leading this emergent boom has been the stylish, fuel-efficient and sturdy four stroke motorcycle that seems to be equally at home on highways and rural byways. In addition, economically active and ambitious consumer class, the relative youth of the population, the substantially lower cost of two-wheeler (as compared to cars) as well as its inherent attractiveness, especially to young male population have played crucial role.

Today with annual sales of over 12 million units, the Indian two-wheeler market is the second largest market in the world after that of China (annual sales of 25 million units). Technically, the two-wheeler industry is divided into five major classifications : mopeds, motorcycles, scooters, step thrus and ungeared scooters. Of all the two-wheelers, motorcycles have registered the maximum growth. In fact motor cycles are the fastest growth segment, with scooter and moped volumes seeing steady decline.

Like passenger car industry, the two wheeler industry has also gained a lot from the availability of easy finance. Financing was a rare of phenomenon till early 1990s but there has been phenomenal growth in this facility and loans are freely available now.

Two wheelers are the most effective safety valve which relieves pressure on urban personal transportation. More than 65 per cent of the two wheeler population is concentrated in urban and semi-urban areas. With public transport being scarce in most cities of India, the two wheelers offer a convenient alternative.

The demography of Indian population is skewed in favour of younger generation, which prefers two wheelers. Therefore, scope of further growth of the industry is great. The younger generation in the age group of 15-34 years comprises more than one-third of the total population and this is expected to increase in the near future. The office-going middle class (typically in the age group of 25 and 59 years) which prefers motorcycle on account of fuel economy, formed 23.5 per cent of the population in 2011, and this is expected to increase further in the near future. Consequently, this segment in expected to progress rapidly in the next ten years.

Although India is the second largest two-wheeler market in the world after China, the penetration levels are low at 38 per thousand people, compared to Indonesia (75), Thailand (150) and Malaysia (220). Thus there is ample scope for this industry to grow fast.

SHIP BUILDING INDUSTRY

India ranks second among the Asian countries next only to Japan in terms of shipping tonnage. However, her shipping fleet is much too small for her dimensions. Ship building is a large and complicated industry which requires huge capital investment. Harbours with large space are ideally suited for this industry.

At present, there are four main centres of ship building industry at Vishakhapatnam, Kolkata, Kochi and Mumbai, all in public sector.

Hindustan Shipyard Ltd., Vishakhapatnam. It was set up by M/s Scindia Steam Navigation Company in 1941 and the first ship was launched on 14th March, 1948. It was taken over by Government

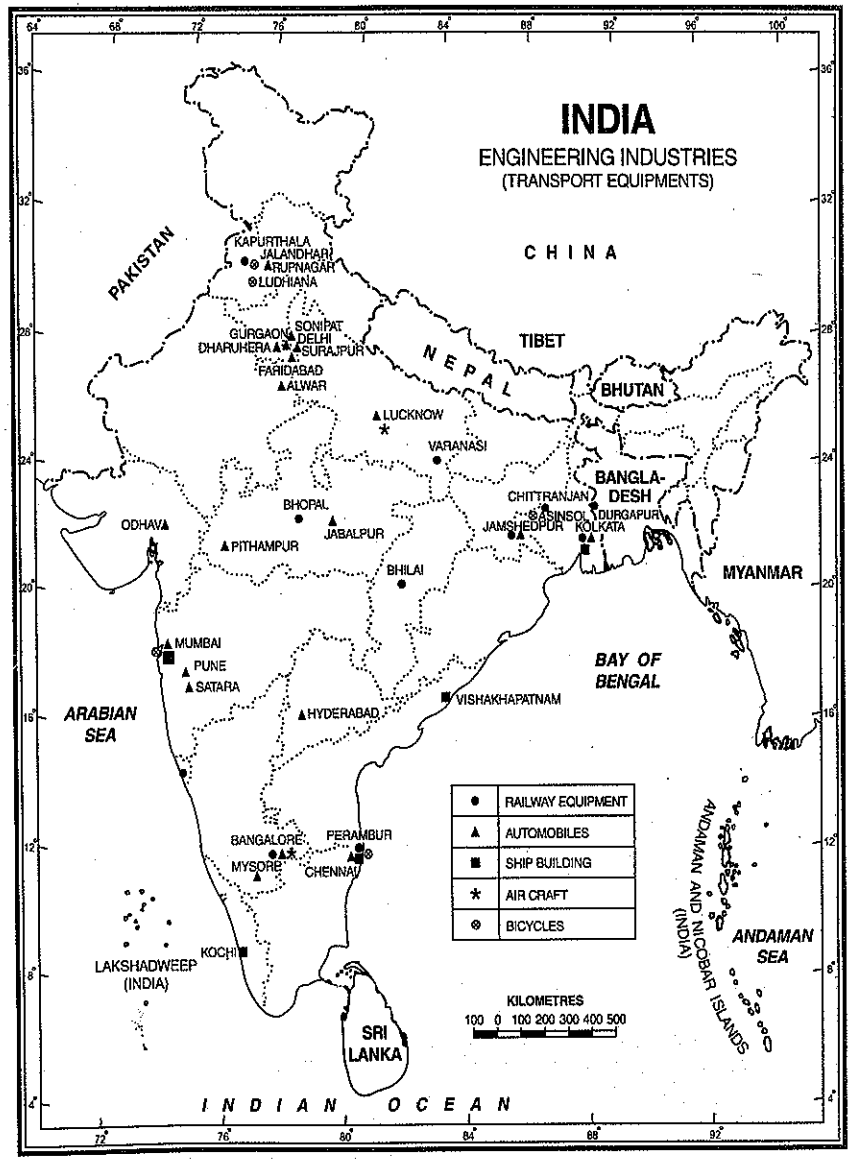


FIG. 25.9. India : Engineering Industry (Transport Equipments)

on 21st Jan., 1952 and was renamed as Hindustan Shipyard Ltd. In 1962, the shipyard became a central public sector enterprise. The shipbuilding capacity of the yard is 3.5 pioneer class vessels of 21,500 Dead Weight Tonnage (DWT) each. The maximum size of the vessel that could be built is 50,000 DWT. The yard has slipways, covered building dock, wet basin and outfit jetty. This is the first shipbuilding yard in the country which was awarded ISO : 9001 certification by Lloyds Register of Quality Assurance, London for international standard of quality assurance. So far as repair of ships is concerned, the yard has facilities of modern dry dock, wet basin repair shops, etc. and it can repair tankers, ships and submarines upto 70,000 DWT. It has so far constructed and delivered 123 vessels of various types.

Cochin Shipyard Limited, Kochi. This shipyard was incorporated on 29 March, 1972 as a company fully owned by the Government. It started commercial production in 1976. The yard is designed to construct ships of size upto 1,10,000 DWT and repair of ships upto 1,25,000 DWT. Till now the yard has constructed and delivered nine large ships (five Bulk Carriers and four Crude Oil Tankers). Recently the yard has delivered the Cargo Launch Vessel, the first export order to its owner National Petroleum Construction Company, Abu Dhabi. It has also constructed 36 vessels. At present, the yard has orders for more Tug Boats from M/s A.A. Tarki Corporation for Trading and Contracting, Saudi Arabia and six bulk carriers of 30,000 DWT each from M/s Clipper Group Management Ltd., Bahamas. Ships for Indian Navy are also built here. The yard has so far repaired 1,000 ships of various types.

Hooghly Dock and Port Engineers Limited Kolkata, became Central Public Sector Undertaking in 1984. The company has two working units in Haora district of West Bengal, one at Salkia and another at Nazirgunge. It has installed capacity of 1,100 tonnes shipbuilding and 125 ship repairs per annum. Apart from dry dock and jetty, it has six slipways. The yard is capable of constructing various types of ships (including passenger ships) and other vessels such as dredgers, tugs, floating dry docks, fishing trawlers, supply-cum-support vessels, barges mooring launches etc. and undertaking repairs of different types of vessels.

The Mazgaon Dock at Mumbai builds dredgers, dock cranes, cruisers, frigates, etc. for the Indian Navy. It can also build ocean-going vessels upto 27,000 DWT. It is capable of building cargo ships, passenger ships and dredgers. It has sub-units at Nhava and Mangalore. Recently it has started constructing submarines, missile boats, destroyers of the Navy and off-shore supply vessels etc for ONGC.

In addition to the above mentioned main centres, there are 33 smaller shipyards manufacturing vessels of small sizes meant for domestic purposes. *Goa Shipyard* Limited (GSL) at Vaso-da-Gama undertakes the manufacture of fibre glass boats, trawlers, dredgers and barges. It has undertaken construction/refit of variety of vessels for Indian Navy and Cost Guard as well for non-defence sector. Presently it is building advanced offshore petrol vessels of in-house design.

AIR CRAFT INDUSTRY

The first aircraft industry was set up at Bengaluru in 1940 under the name of Hindustan Aircraft Ltd. It was a private company and was taken over by the government in 1942. This factory was merged into Aeronautics India Ltd. in 1964 to form Hindustan Aeronautics Ltd. (HAL), Bengaluru. Different parts of aircrafts are manufactured at different places due to security reasons. The main divisions of the HAL are : (*i*) A three unit MIG complex comprising the Nashik Division where MIG airframe is manufactured. (*ii*) the Koraput division where the engine for MIG aircraft is manufactured and (*iii*) the Hyderated division where electronic equipment for the MIG is manufactured. Transport aircrafts are manufactured at Kanpur. Recently a factory was set up at Lucknow for producing equipment for aircraft. Among the other major products, mention may be made of Jaguars, Marut, Gnat Fighter Aircraft, Jet Trainer Aircraft, etc. and some helicopters. The first prototype of light combat aircraft (LCA) rolled out in November 1995.

BICYCLES

Bicycle is a poor man's drive and is much suited to the economic condition of Indian masses. It is the most convenient and popular mode of transportation among the lower and middle income groups.

Presently, over sixty million bicycles are being used in the country. The first bicycle manufacturing factory was set up at Mumbai in 1940. At present, there are about 13 units manufacturing complete cycles and over 40 units manufacturing cycle parts. The main centres of bicycle production are Mumbai, Asansol, Sonipat, Delhi, Chennai, Jalandhar and Ludhiana. Ludhiana has emerged as the major bicycle production hub in the country. This industry has made rapid strides during the last four decades. The production has increased from 99 thousand bicycles in 1950-51 to 13,046.14 thousand bicycles in 2012-13. This progress has made India the second largest producer after China. Hero, Atlas, TI and Avon account for 92 per cent of the production in the organised sector.

India has emerged as a major exporter of cycles to Pakistan, Afghanistan, Sri Lanka, Myanmar, Thailand, UAR, Turkey, Indonesia, Malayasia and Singapore. Indian exports of bicycles and components was around ₹ 281 crore in 2012-13. There has been a significant increase in exports to South America and African and European countries since 1991.

The bicycle industry is de-licenced under the current industrial policy and this sector is qualified for 100 per cent FDI under automatic approval.

LIGHT MECHANICAL ENGINEERING GOODS

India produces a wide range of light mechanical engineering goods. The important items are sewing machines, office equipment, etc. The main centres of sewing machine production are Mumbai, Delhi, Secunderabad and Jalandhar. The production of sewing machines is showing varying trend.

ELECTRIC MACHINERY AND EQUIPMENT MAKING INDUSTRY

Electricity is an integral part of modern life. The increase in generation, distribution and utilisation of electricity has resulted in increased demand for electrical machinery and equipment in the recent past. Consequently, this industry has made rapid strides during the last two-three decades. This industry is divided into two components *viz.* (*i*) heavy electrical equipment industry and (*ii*) light electrical goods industry.

Heavy Electrical Equipment Industry

Heavy electrical industry comprises equipment used for the generation, transmission, distribution and utilisation of power. It includes items such as generators, boilers, turbines, transformers, switchgears, etc. The indigenous industry is equipped to meet the entire domestic requirement. The entire industry has been delicensed under the New Industrial Policy of the Government of India. Also under the New Policy, these items qualify for automatic approval as regards to foreign collaborations. Heavy electrical equipment is mainly manufactured by the government owned factories which have been set up with foreign financial assistance and technical skill. This industry took its birth in 1956 when Heavy Electricals (India) Ltd. was set up at Bhopal with British help. It started production in 1960. Another company known as the Bharat Heavy Electricals was formed in 1964. The two organisations have since been merged to form Bharat Heavy Electricals Ltd. (BHEL). BHEL is an important milestone in the development of heavy electrical equipment industry. In last about five decades since its inception, BHEL has taken the country from a position of total dependence on imports to self-reliance in power plant design, manufacture, installation and servicing. The sets manufactured and supplied by BHEL now account for 65.3 per cent of the country's installed power generation capacity. With an annual production capacity of 4,000 MW, BHEL ranks among the most important power equipment manufacturers in the world. To meet the demand for rapid growth in power generation, BHEL has steadily introduced higher capacity boilers—right upto 500 MW unit sizes. BHEL boilers and auxiliaries have also been exported to Libya, Malayasia and Egypt and boiler assemblies to China and the U.S.A. It has six units located at Bhopal, Tiruchchirapalli, Ramchandrapuram (Hyderabad), Jammu, Bengaluru and Haridwar. The Bhopal unit produces heavy electrical equipment required for the generation, transmission and distribution of power. These include hydraulic and steam turbines, generators and motors and traction equipment. The plant at Tiruchchirapalli in Tamil Nadu produces high pressure boilers. The Ramchandrapuram unit (Hyderabad) in Telangana has heavy power equipment plant which has a capacity to manufacture 800 MW of steam turbines and turbo-

alternatives per annum. It also produces air blast circuit breakers and minimum oil circuit breakers. The Haridwar Unit produces steam turbines. Some items of heavy electrical industry are produced at Jammu and Bengaluru.

Power Transformers. There are 33 units in the organised sector manufacturing power and distribution transformers. Transformers of 100 KVA capacity are mainly produced by small scale units. Most of the production comes from Mumbai, Chennai, Vishakhapatnam, Kolkata and Sonipat.

Electric Motors. India produces a wide range of electric motors to meet the requirements of industries, tube wells, pumping sets and electric traction. Heavy motors are manufactured by government factories while small motors are made by private factories. Mumbai, Chennai, Bangalore, Kolkata, Pune, Patiala, Delhi, Coimbatore, etc. are the main centres of motor manufacturing.

Electric Wires and Cables. Wires and cables whether they are made of fibre, optics, iron or non-ferrous (copper, aluminium, zinc), play a significant role in almost all areas of industrial and daily life. This is one of the earliest industries established in India in the field of electrical products. India produces a wide range of wires and cables which includes communication cables such as jelly fitted telephone cables, optic fibre cables, local area cables, switchboard cables, co-axial cables, electrical cables such as electrical wires, winding wires, automatic/battery cables, UPS cables, flexible wires, low voltage power cables, etc. The power cable industry is mainly divided into four segments *viz.* house wiring (upto 440 V), LT (1.1 to 3.3 KV), HT (11 to 66 KV), EHT (66 KV and above).

It is a fast developing industry as it has received a big boost from various government policies. In the year 2012-13, the non-small scale industry (SSI) sector reported production of insulated cable wire of all kinds at 53.70 lakh core rims. In 2011-12, India exported wires and cables worth ₹ 2800.09 crore. The industry is de-licenced and is eligible for automatic approval for FDI upto 100 per cent.

Transmission Towers. Transmission towers support high voltage transmission lines which carry electricity over long distances. Demand for transmission towers has increased considerably with the rapid pace of electricity distribution over long distances from the electricity generating stations to the consuming areas. The country has sufficient capacity to cater to the domestic demands. During the year 2012-13, India imported transmission towers worth ₹ 100.53 crore against a huge export of ₹ 1,515.27 crore.

Cranes. Cranes and hoists are an important category of material handling equipment required by almost all sectors of industry. India produces a wide range of cranes which include Electric Overhead Travelling (EOT) cranes, mobile cranes, ladle cranes, hydraulic decks, crab cranes, floating cranes, controller cranes, etc. There is good potential for growth of this industry in India. In the year 2012-13, India produced 17,417 tonnes of cranes. During the same year, India imported cranes worth ₹ 2,305.8 crore while the exports were worth ₹ 716.40 crore. The industry is de-licenced and is eligible for automatic approval for FDI upto 100 per cent.

Lifts and Escalators. During the recent past, Indian cities have tended to grow vertically due to fast growing urban population and also because of limited availability of land in urban areas. Consequently lifts and escalators have become the corner stone to support this development and lifeline for the buildings that constitute this development. Rapid urbanization and robust activity in the construction industry and corporalization of the real estate sector has led to a vary healthy growth of this industry. The use of lifts and escalators is increasing rapidly due to substantial investment in construction of multistoried housing complexes, large malls and supermarkets of international standards, modernization of airports and railway stations apart from industrial sectors. A wide range of lifts and escalators are manufactured in the country which include single speed, double speed, glearless, hydraulic, servo and Variable Voltage Variable Frequency (VVVF) elevators. In the year 2012-13, India produced lifts and escalators worth ₹ 1,053.34 crores. In the same year, the import was ₹ 2,261.45 crores against export of ₹ 296.25 crore. The industry is de-licenced and is eligible for automatic approval for FDI upto 100 per cent.

Light Electrical Goods Industry

This industry covers a wide range of products which include white goods (refrigerators, washing machines, air conditioners, etc.), household electric appliances, electric fans, storage batteries, dry cells, wiring accessories, fittings, electric lamps, etc.

Refrigerators. In India, refrigerators have the second highest aspirational value, next only to television. It is on account of this fact that this industry has witnessed extremely high growth rate during the last few years. This industry has become highly competitive as a number of brands, both national and international, have entered the market. In the year 2012-13, India produced 8,685.45 thousand units. During the same year, India exported refrigerators worth ₹ 1,225.57 crores. against the imports of ₹ 2,248.75 crores. The industry is delicensed and its eligible for automatic approval for FDI upto 100 per cent

Washing Machines. With growing number of working couples and higher aspirations as well as higher purchasing power of the urban middle class families, washing machines have become an integral part of domestic electrical appliances in most of the families. More efficient and energy saving washing machines are hitting the market every day as the technology advances. In the year 2012-13, India produced 32.24 lakh units. Even now India imports a variety of washing machines. In the year 2012-13, India imported washing machines worth ₹ 864.9 crores while the exports in the same year were worth ₹ 103.07 crore. The industry is de-licenced and eligible for automatic approval for FDI without any restriction.

Air Conditioners. Air conditioners are gradually being treated as a necessity in the changed socio-economic environment of the present day life in India. There are three types of ACs available in the market *viz.* window AC, split AC and central AC. Star rating of ACs has been introduced for energy efficiency. Market for ACs has grown considerably during the last few years. In 2012-13, India produced 18.97 lakh units. In the same year, exports of ACs account for ₹ 364.21 crore, against imports worth ₹ 5,073.69. The industry is de-licenced and eligible for automatic approval for FDI upto 100 per cent.

Electric Fans. India is one of the foremost producers of electric fans in the world. A complete range of electric fans such as ceiling fans, table fans, pedestal fans, exhaust fans, cooler fans, railway carriage fans, cabin fans and air circulators are being produced in different parts of the country. Mumbai, Kolkata, Secunderabad, Chennai, Delhi, etc. are the leading centres for production of electric fans.

Electric Lamps. This industry was established in 1932 and has made tremendous progress, especially after Independence. The range of electric lamps includes mercury vapour lamps, automobile lamps, photoflash lamps, miniature lamps for torches and flourescent tubes. There is an urgent need for energy conservation which has encouraged the need for manufacture of energy efficient electric lamps. Compact Fluorescent Lamps (CFL) which consume about 20% of electricity for the same light output and last upto 8 times longer than the GLS are getting more popular. The industry is receiving adequate encouragement from the Government. A number of foreign collaborations have already been approved for manufacture of energy efficient lamps. During 2012-13, the production of GLS lamps and fluorescent tubes was 784.44 million numbers and 182.21 million numbers respectively. In the same year the imports and exports of these items were worth ₹ 1,497.27 crore and ₹ 739.90 crore respectively.

Dry and Storage Batteries. Established in 1926, this industry flourished well after the Second World War. Almost all types of dry and storage batteries are produced in the country. Storage batteries are required for automobile industry, train lighting, posts and telegraphs apparatus, power houses and for traction. New units are coming up and the process of upgradation of technology in this industry is continuously benefitting the producer and customer alike.

Radio Receivers. This industry made a beginning in 1947 with a modest production of less than 4,000 sets. The production reached a peak of 1,734 thousand sets in 1980-81 and nose dived to a mere 0.7 thousand in 2003-04. The main reason for this drastic fall in the production of radio receivers is attributed to the growing popularity of television sets.

Electronics Industry

This industry covers a wide range of products including television sets, transistor sets, telephone exchanges, cellular telecom, paging, computers, and varied equipments for posts and telegraph, defence, railway and meteorological departments. It is

practically a post-independence phenomenon and has revolutionised the life style of the Indian masses in the recent past. Bengaluru is the largest centre of electronics goods production and is rightly termed as the ***Electronic Capital of India***. The other major producing centres are Hyderabad, Delhi, Mumbai, Chennai, Kolkata, Kanpur, Pune, Lucknow, Jaipur, Coimbatore, etc.

Information Technology

Two main components of Information Technology (IT) are software and hardware.

The software has emerged as the major industry in the field of electronics. This industry made a modest beginning in the 1970s and by mid-1980s, the forecasters, analysts and policy planners started understanding the potential of computer software application. The industry achieved a major breakthrough in the 1990s and is now one of the important industries of India. The main cause of the rapid development of software industry is its vast reservoir of technically skilled manpower which has transformed India into a software super power. With a compound annual growth of about 52 per cent between 1991 and 1996, the Indian software sector has expanded almost twice as fast as the world's leading US software industry did, during the same period, although from a smaller base. There is now a critical mass of more than 500 software firms in the country and apart from these companies, there are an additional 1,000 start-up-companies. Today, India is one country that offers cost-effectiveness, great quality, high reliability, speedy deliveries and, above all, the use of state-of-the-art technologies in software industry. The year 1995-96 was a boom year for the Indian computer industry and the Information Technology (IT) industry of India really exploded in that year.

Despite the challenges such as the continued technology slowdown in the global market, strong fundamentals and core value position of the software and services industry led to outperforming all other sectors in the country. Today, India dominates the word scene with respect to software technology.

Hardware. The hardware segment of Information Technology (IT) industry is one of the fastest growing industry in terms of production, international trade and is characterised by innovation. According to a recent study, by 2020, the global electronics industry would cross $ 1.5 trillion mark and Indian electronic hardware industry may be well over $ 100 billion by then. This will offer employment opportunities to over 10 million persons.

After liberalisation in 1991, India is fast catching up with the world in terms of penetration of IT, telecommunications and consumer electronics products. This can lead to a huge demand for these products as well as provide base for global competition.

"The Personal Computer (PC), not TV, will be the key information appliance of 21st century," said Andy Grove, co-founder of Intel, the world's largest chip-maker over a decade ago. He was proved right in the U.S. before the turn of the 20th century when for the first time PCs outsold TVs. This has not happened in India, and may not happen for another decade. But PCs are gaining more popularity in India as compared to TVs as the time passes.

The phenomenal increase in PC sales can be attributed to home segment which posted a growth of 48 per cent. Significant consumption by telecom, banking, manufacturing as well as business process outsourcing (BPO) and IT enabled services (ITES) segment also contributed to rise in PC sales. India has emerged as the most preferred destination for BPO, a key driver of growth of software industry and the service sector. Smaller cities and towns fueled the IT consumption with class C cities accounting for over 50 per cent of total PC sales.

The Department of Information Technology has drafted a wholesome IT hardware policy which addresses the basic problems faced by this industry. This policy must be implemented to rid the industry of the ills it is currently facing.

The vision of IT policy is to use IT as a tool for raising the living standards of the common man and enriching their lives. Towards this end, the Department of Information Technology has taken up an ambitious programme of PC and Internet penetration to the rural and underserved urban areas. The Department has also announced a programme to establish State Wide Area Network (SWAN) up to the block level to provide connectivity for e-governance. The Department has also set up Community Information Centres (CICs) in hilly, far-flung areas of the North-East and Jammu and Kashmir to facilitate the spread of benefit of information and communication technology. It is also proposed to set up CICs in other hilly, far-flung areas of the country like Uttarakhand, Andaman & Nicobar and Lakshadweep.

A mixture of software and hardware technology lies at the heart of burgeoning business of embedded system design and India is emerging as a key centre for products for both local and global players. IT infrastructural facilities (software as well as hardware) are available at a number of places in India (*see* **Fig. 25.10**).

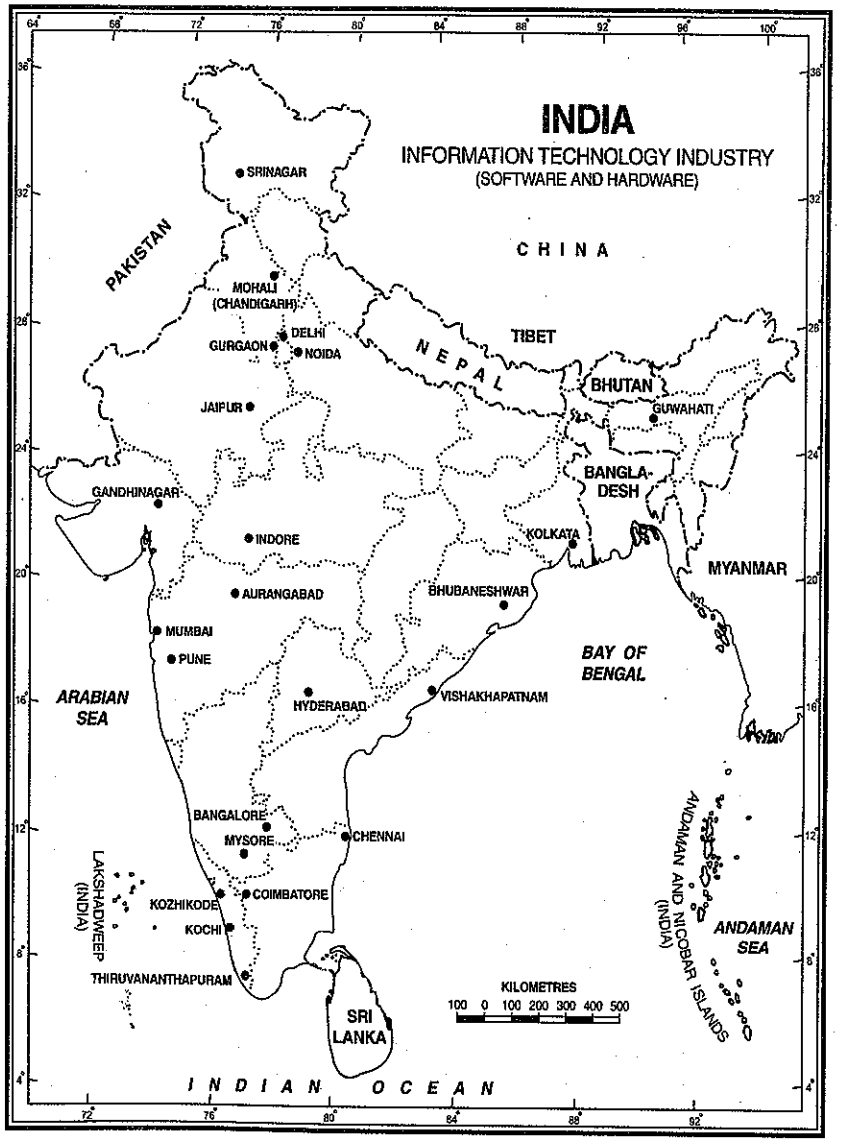


FIG. 25.10. India : Information Technology Industry (Software and Hardware)

The television industry had also grown tremendously in the 1990s. The market size is about 2.5 million units with top four brands taking up over 80 per cent of the share. BPL and Videocon are on the top and accounted for 26 per cent each of the market shares. They are followed by Onida and Phillips. Among the international brands, Panasonic, Soni and Akai are famous. LG has also become quite popular It is now asserted that TV has entered the smallest of homes and the tiniest of villages and communities.

The production of ***audio systems*** has registered a phenomenal growth during the recent past. The audio industry can broadly be classified as mono players, stereo players, midi systems, CD based systems and car audios. The present size of the Indian audio market is estimated at ₹ 2,000 crore and this is growing at an annual rate of 15-16 per cent. The mono players and stereo players contribute more than 50 per cent of the total market. The top three players in the Indian audio systems industry are Philips, BPL and Videocon. These three makers account for 35 per cent, 20 per cent and 10 per cent respectively with the remaining 35 per cent share of the market going to smaller brands and the unorganised sector.

Indian electronics industry is also contributing a lot to space technology. India has launched several indigenously built satellites including APPLE, INSAT-1 series. The remote sensing programme of the Indian Remote Sensing Organisation at Hyderabad has also gained a lot from this industry.

CHEMICAL AND ALLIED INDUSTRIES

Chemical and allied industries constitute one of the most vital and essential components of the country's economy. Although chemical industry made a late start and is still a nascent industry in India, it has undergone a metamorphosis during the last four decades. This change has become more perceptible after the liberalisation of industrial policy in 1991. At present, it is the fourth largest set of industries after textiles, iron and steel and engineering industries. This set of industries can claim to be one of the top sectors of the economy to have responded well and benefited significantly by taking advantage of the stimulii for growth injected in recent years. The large manufacturing capacities commissioned for several chemical industries and still larger capacities to go on stream within another five years, have pushed the status of the Indian chemical industry forward in the comity of chemical manufacturing nations. The rate of growth of the chemical sector has been higher than the average growth rate of the Indian industry. During the last decade the industry has been growing at the rate of 10 per cent per annum. The present annual turnover in the chemical sector in India is estimated to be well over ₹ 40,000 crore.

HEAVY INORGANIC CHEMICALS

Sulphuric Acid. Sulphuric acid is used as an important ingredient for manufacturing fertilizers, synthetic fibres, plastics, paints and dyestuffs. It is also used in metallurgy, leather tanning and oil refining. It is manufactured from sulphur which is not available in appreciable quantity in India. About 90 per cent of the sulphur has to be imported. There are over one hundred units engaged in the manufacture of sulphuric acid. About 80 per cent of the production comes from Kerala, Maharashtra, Gujarat, Tamil Nadu, Madhya Pradesh, Chhattisgarh and West Bengal. The rest is contributed by Jharkhand, Andhra Pradesh, Telangana, Uttar Pradesh, Delhi, Karnataka, Assam, Punjab, Rajasthan and Odisha. Important centres of production are Mumbai, Trombay, Chennai, Kalyan, Jamshedpur, Delhi, Kolkata, Bumpur, Udaipur, Alwaye, Debari and Khetri.

Nitric acid. The production and use of nitric acid is associated with fertilizer plants and explosives. Trombay unit of Fertilizer Corporation of India is the main producer.

Alkalies. Alkalies form an important segment of inorganic chemical industry and the demand for alkalies is growing very fast as a result of growth of industries using them as essential inputs. The manufacturing of alkalies requires heavy and weight loosing raw materials like common salt (sodium chloride), limestone and coal. The final product has much less weight in comparison to the weight of the raw materials. This industry also requires cheap electricity in abundance. Thus the plants manufacturing alkalies tend to be located near the source of raw materials, electricity and market. The alkali industry comprises soda ash, caustic soda, liquid chlorine, calcium carbide, etc.

Soda Ash. It is used in the manufacture of glass, paper, soaps and detergents. Two chief raw materials used in the manufacture of soda ash are sodium chloride and limestone which are abundantly found in Gujarat. Okha, Mithapur and Dhrangadhra are important centres of manufacturing soda ash. The other centres are Sutrapada, Varanasi, Nangal and Tuticorin. The production of soda ash consistently increased from a meagre 46 thousand tonnes in 1950-51 to 1,631 thousand tonnes in 2000-01 and 2,427 thousand tonnes in 2011-12.

Caustic Soda. The caustic soda industry has grown steadily since the first plant, with a capacity of five tonnes a day, was put up at Mettur in 1936. It meets the needs of end-user industries like textiles, soaps and detergents and alumina. Its by-product, chlorine is an important chemical used in water treatment, paper and pulp, soaps and detergents, textiles and a large variety of other industries. The industry is growing at a rate of six per cent per annum in India whereas, internationally, the growth rate is around two per cent.

The basic raw material used for manufacturing caustic soda is common salt which is available in plenty in India. It is a highly power intensive industry and the cost of power constitutes more than two-thirds of the total cost of production of caustic soda. The major producing centres are Porbandar, Thane, Kalyan, Mithapur and Titagarh.

HEAVY ORGANIC CHEMICALS

Petrochemicals. Petrochemicals are those chemicals and compounds which are derived from petroleum resources. The main sources of feedstock and fuel for petrochemicals are natural gas and naphtha. These chemicals are used for manufacturing a large variety of articles such as synthetic fibres, synthetic rubber, ferrous and non-ferrous metals, plastics, dye-stuffs, insecticides, drugs and pharmaceuticals. Today, petrochemicals products permeate the entire spectrum of items of daily use, ranging across clothing, housing construction, furniture, automobiles, household items, toys, agriculture, irrigation and packaging to medical appliances.

This is one of the fastest growing industries in the Indian economy. The demand for organic chemicals increased so rapidly that it became difficult to meet them by chemicals prepared from alcohol, calcium carbide, and coal. At the same time, petroleum refining industry expanded rapidly. Many things are derived from crude petroleum, which provide raw materials to several new industries; these are collectively known as petrochemical industries. This group of industries is divisible into four sub-groups : (*i*) polymers, (*ii*) synthetic fibres (*iii*) elastomers, and (*iv*) surfactant intermediate. Mumbai is the hub of petrochemical industries. Cracker units are also located in Auraiya (Uttar Pradesh), Jamnagar, Gandhar, Hazira (Gujarat) Nagothane, Ratnagiri (Maharashtra), Haldia (West Bengal) and Vishakhapatnam (Andhra Pradesh).

Three organisations are working in the petrochemical sector under the administrative control of the Department of Chemicals and Petrochemicals.

(*i*) Indian Petrochemical Corporation Limited (IPCL) is a public sector undertaking which is responsible for the manufacture and distribution of various petrochemicals like polymers, chemicals, fibres and fibre intermediates.

(*iii*) Petrofils Cooperative Limited (PCL) is a joint venture company of the Government of India and Weavers' cooperative societies. It produces polyester filament yarn and nylon filament yarn at its two plants located at Vadodara and Naldhari in Gujarat.

(*iii*) Central Institute of Plastics Engineering and Technology (CIPET) is involved in imparting training.

Synthetic Fibres

These are widely used for manufacturing a large variety of fabrics because of their special qualities like strength, durability, dyeability, workability, washability and resistant to wrinkles and shrinkage. These fabrics are very popular among the masses in India, both in urban and rural areas. Although nylon industry made a beginning immediately after the World War II, the real progress was made in 1960s. The main cause of rapid progress in this period was the availability of feedstock from petroleum refineries. Units manufacturing nylon filament and polyester filament yarns are at Kota, Pimpri, Mumbai, Modinagar, Pune, Ujjain, Nagpur and Udhana.

TABLE 25.16. Production of Selected Petro Chemicals (thousand metric tonnes)

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Synthetic Fibres	2,251	2,524	2,343	2,600	2,791	2,697
Polymers	5,183	5,303	5,061	4,792	5,292	6,211
Elastomers (Synthetic Rubber)	95	104	96	105	94	88
Synthetic detergent intermediates	556	585	551	618	639	623
Performance Plastics	132	156	140	172	192	183
Total Major Petrochemicals	8,517	8,672	8,190	8,267	9,008	9,802

Source : India 2014, A Reference Annual, p. 547.

Acrylic staple fibre is manufactured at Kota and Vadodara. Plants of polyester staple fibre are at Thane, Ghaziabad, Manali, Kota and Vadodara.

Polymers

Polymers are made from ethylene and propylene. These materials are obtained in the process of refining crude oil in the refineries. Polymers provide the basic raw material for plastic industry. Among polymers, polyethylene is a widely used thermoplastic. Plastic is first converted into sheets, powder, resin and pellets, and then used for manufacturing plastic products. Plastic is a very useful industrial product in the modern day life.

Attempts to manufacture plastic polymers in India were made in late 1950s and early 1960s using other organic chemicals. The National Organic Chemical Industries Limited (NOCIL), instituted by the Mafatlal Group in 1961 started first naphtha based chemical industry at Mumbai. Later several other companies were formed. Mumbai, Barauni, Mettur, Pimpri and Rishra are major producers of plastic materials. The production of polymers (polyethylenes, polypropylene, poly-vinyl chloride and polystyrene) increased.

Production of polymers increased from 5,183 thousand metric tonnes in 2006-07 to 6,211 thousand metric tonnes in 2011-12, registering a growth rate of 19.8 per cent during this period.

The Plastic Processing Industry is making available quality products at reasonable prices to a diverse range of consumer demand in the country. There are about 20,000 units engaged in manufacturing various plastic products. Nearly three-fourths of these units are in small-scale sector which account for 20-25 per cent of total polymer consumption. With a total investment of ₹ 15,000 crore, the industry gives the annual turnover of ₹ 25,000 crore. The present installed capacity of these units is of the order of 6-7 million tonnes. The industry has an average annual growth rate of 15 per cent and employs three million people directly. The industry processes about 3.6 million tonnes of prime or virgin polymers and 1.4 million tonnes (or 30 per cent of the total of reprocessed materials (recycled plastic).

Elastomers, Surfactants and Performance Plastics. The production of elastomers which mainly comprise of styrene butadiene rubber and poly butadiene rubber (SRB and PBR) increased from 95 thousand MT in 2006-07 to 105 thousand MT in 2009-10, back-fell to 88 thousand tonnes in 2011-12 **(Table 25.16)**. With one plant of SBR lying idle in the country the capacity utilisation of these elastomers was just 55 per cent to 60 per cent.

Surfactant Intermediates, which are generally used in the detergent industry, comprise of Linear Alkyl Benzene and Ethylene oxide. There has been a growth in production of these surfactants from 556 thousand tonnes in 2006-07 to 623 thousand tonnes in 2011-12.

FERTILIZERS

Indian soils are generally deficient in fertilizing elements namely nitrogen, phosphorus and potassium and do not give high yields. It is, therefore, essential to feed these soils with chemical fertilizers so that their productivity increases. The significant contribution made by the chemical fertilizers can be seen from the impact of the Green Revolution on

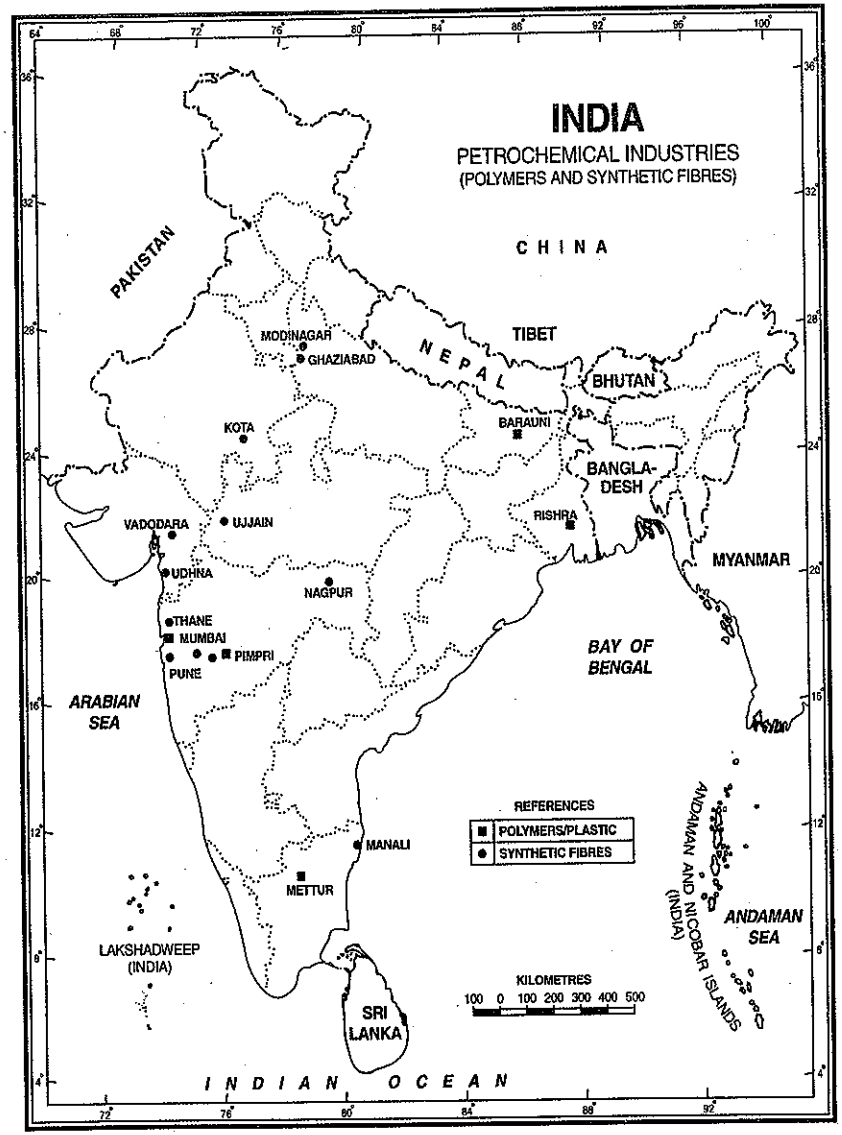


FIG. 25.11. India : Petrochemical Industries (Polymers and Synthetic Fibres)

Indian agriculture. The production of food grains increased from a miserably low of 50.82 million tonnes in 1950-51 to 255.36 million tonnes in 2012-13. The health and growth of the fertilizer industry is vital for increasing the growth of agricultural sector, to meet the foodgrain requirements of increasing population as well as increasing contribution to exports. We can ignore the significance of fertilizers for food production only at the cost of nation's welfare. The major role which fertilizers have played in raising the country's foodgrains production can be seen from the increase in fertilizer consumption from 0.55 kg per hectare in 1951-52 to 128.3 kg in 2011-12. This is much lower as compared to 368.7

kg/ha in Egypt, 209 kg/ha in Bangladesh, 269.7 kg/ha in Korea Republic, 265 kg/ha in Malaysia and 223.9 kg/ha in Vietnam.

Localisation

The localisation of fertilizer industry is closely related to petrochemicals. About 70 per cent of the plants producing nitrogenous fertilizer use naphtha as the basic raw material. That is why, most of the fertilizer plants are located near the oil refineries. However, some fertilizer plants draw their feed stock from steel slag as well as coke and lignite. Phosphatic fertilizer plants are primarily dependent upon mineral phosphate which is available in Uttar Pradesh, Madhya Pradesh and Rajasthan. Some plants are based on imported phosphate mineral. Sulphur is another important mineral used for manufacturing fertilizers. This is available in Tamil Nadu. During the recent years transportation of Neptha or Gas through rail or pipelines has facilitated the widespread distribution of fertilizer plants with priority to seaboard location. The HBJ Gas pipeline has given birth to six gas based fertilizer plants at Vijaypur, Jagdishpur, Aonla, Gadipan, Babrala and Shahajahanpur.

Growth and Distribution

A modest beginning with respect to manufacturing of chemcial fertilizers was made in 1906 when the first super-phosphate factory was set up at Ranipet in Tamil Nadu. The actual growth of fertilizer indsutry is mainly a post-Independence phenomena. The setting up of the Sindri plant by the Fertilizer Corporation of India Ltd. (FCI) in 1951 was a turning point and this industry did not look back after that.

It is now one of the fastest growing basic industries which has taken rapid strides in recent years. It produces a wide range of fertilizers to suit different soil and crop requirements in different parts of the country. India is now the third largest producer of nitrogenous fertilizers in the world only behind China and U.S.A. At present, there are 56 large size fertilizer units manufacturing a wide range of nitrogenous and complex fertilizers, including 29 units producing urea and 9 units producing ammonia sulphate as a by-product. Besides, there are about 72 medium and small scale units producing single superphosphate (SSP). The total installed capacity of fertilizer production which was 119.60 lakh metric tonnes in 2004, has marginally increased to 120.61 lakh metric tonnes in 2012-13.

Gujarat, Tamil Nadu, Uttar Pradesh, Maharashtra, Andhra Pradesh, Punjab and Kerala are the main fertilizer producing states and account for about half of the total fertilizers produced in India. Odisha, Rajasthan, Bihar, Assam, West Bengal, Goa, Delhi, Madhya Pradesh and Karnataka are the other producers.

1. Gujarat. Gujarat is the largest producer of fertilizers in India and accounts for more than one-fourth of the total production of nitrogenous as well as phosphatic fertilizers of the country. This state has more than 14% of the country's total installed capacity. Units at Vadodara and Kalol produce both nitrogenous and phosphatic fertilizers while units at Bharuch, Udhna, Kandla, Bhavnagar and Vadodara produce phosphates only. Two new plants have been set up at Hazira and Surat. Ahmedabad and Navsari are also important producers.

2. Tamil Nadu. This state accounts for about 11 per cent of the country's installed capacity. At present Tamil Nadu is the second largest producer of phosphatic fertilizers (about 16%) and the fourth largest producer of nitrogenous fertilizers accounting for nearly 9% of India. Nearly 65 per cent of the capacity is for nitrogenous fertilizers. Neyveli, Ranipet, Tuticorin, Ennore, Coimbatore, Mettur Dam, Cuddalore, Avadi and Manali are the main producing centres.

3. Uttar Pradesh. This state accounts for about 9 per cent of the country's total installed capacity. About 17 per cent of nitrogenous and 3.4 per cent of phosphate fertilizers of India are produced in Uttar Pradesh. Important centres of fertilizer production in Uttar Pradesh are Kanpur, Phulpur, Gorakhpur, Varanasi and Magarwara. New plants have been set up at Babrola, Aonla, Shahjahanpur and Jagdishpur.

4. Maharashtra. Maharashtra accounts for over 11 per cent of the nitrogenous and about 7 per cent of the phosphatic fertilizers of the country. The state has six plants in all. Mumbai with three plants is the largest producer. The remaining three plants are located at Trombay, Ambarnath and Loni-Kalbhor.

5. Andhra Pradesh and Telangana These states together account for about 7 per cent of the total installed capacity and produces about 11 per cent of the phosphate and 3.5 per cent of nitrogenous fertilizers of India. The main centres of production are Vishakhapatnam, Ramagudam, Kakinada, Maula Ali (Hyderabad), Tadepalli, Tanukur and Nidadavole.

6. Odisha. Odisha has 6 per cent of the total installed capacity and produces 11.6 per cent of the phosphate and 3 per cent of nitrogenous fertilizers of India. The industry is located at Rourkela, Talcher, and Paradwip.

7. Kerala. Kerala also accounts for 6 per cent of the total installed capacity and produces about 6 per cent phosphatic and 3.5 per cent nitrogenous fertilizers of India. Its fertilizer units are located at Alwaye, Kochi and Karimnangalam.

8. Rajasthan. This state has 5 per cent of the country's total installed capacity and accounts for about 2.3 per cent of nitrogenous and 1.6 per cent of phosphatic fertilizers of India. More than half of the state's production comes from Kota. Debari, Khetri, Saladipur (Sikar district) and Chittaurgarh are the other important centres.

Others. *Bihar*—Sindri and Barauni, *Jharkhand*—Jamshedpur and Dhanbad, *Punjab*—Nangal and Bhatinda, *West Bengal*—Burnpur, Durgapur, Rishra, Kharda, Haldia, *Chhattisgarh*—Bhilai, Kumhari and Korba, *Assam*—Namrup and Chadrapur, *Karnataka*—Mangalore, Hubli, Mandya, Belagota and Munirchad, *Haryana*—Panipat, *Goa*—Sancoale (near Vasco) are other centres.

Public Sector Undertakings

The public sector undertakings are playing a dominant role in manufacturing chemical fertilizers. At present, there are 11 public sector undertakings under the administrative control of Department of Fertilizers.

1. The Fertilizer Corporation of India (FCI) was incorporated in January, 1961. It has four units one each at Sindri (Bihar), Gorakhpur (U.P.), Talcher (Odisha) and Ramagundam (Telangana). Its total installed capacity is 8.06 lakh tonnes of nitrogen.

2. The National Fertilizers Limited (NFL) was established on 23 August 1974. It has six units, *viz.*, the Calcium Ammonium Nitrate (CAN) plant at Nangal and the Urea plants at Nangal, Bhatinda, Panipat and Vijaipur (two units). It has a total installed capacity of 15.66 lakh tonnes of nitrogen and is the largest producer of nitrogenous fertilizers in the country.

3. The Fertilizers and Chemicals Travancore Limited (FACT) has three operating units out of which one is at Udyogamandal and two are at Kochi.

4. The Rashtriya Chemicals and Fertilizers Ltd. (RCF) is operating five fertilizer plants at Trombay set up during the period from October 1965 to July 1982 and a large gas-based fertilizer plant at Thal which started production in 1985. The installed capacity of RCF plants is 9.55 lakh metric tonnes of nitrogen and 1.20 lakh metric tonnes of phosphate.

5. The Hindustan Fertilizer Corporation Limited (HFCL) has total annual installed capacity of 6.54 lakh tonnes of nitrogen. Out of a total of five units under its control, three are at Namrup (Assam) and one each at Durgapur (W. Bengal) and Barauni (Bihar). HFCL and Fertilizer Corporation of India (FCI) were declared sick in November 1992. After considering the rehabilitation proposals of these two PSUs, the Government decided to close down HFCL and FCI on 5th September, 2002, excepting its Jodhpur Mining Organisation which has been hived off into a new company.

6. The Madras Fertilizers Limited (MFL) is a joint venture of the Government of India and the National Iranian Oil Company. Its plant at Manali (Chennai) has an annual installed capacity of 3.67 lakh tonnes of nitrogen and 1.43 lakh tonnes of phosphate.

7. Pyrites, Phosphates and Chemicals Limited (PPCL) was set up in March 1960. It is engaged in exploration of pyrites deposits as well as production of single super phosphate at Amjhore (Bihar), exploration-cum-production mining of pyrites deposits at Saladipura in Rajasthan and mining of rock phosphate ore from the Mussoorie phosphorite deposits. The company was declared as a sick company in April 2000 and was closed down on November 20, 2000.

8. Project and Development India Limited (PDIL) formerly known as Fertilizer Planning and Development India Limited, is engaged in design,

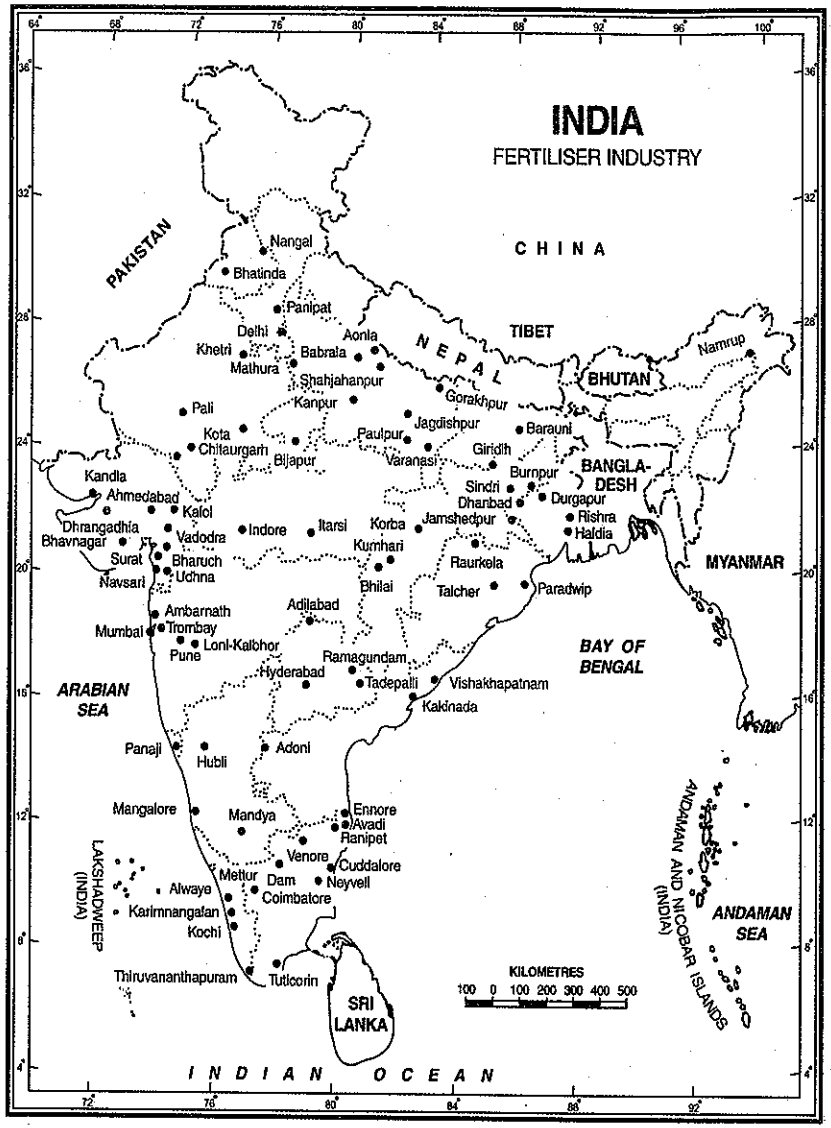


FIG. 25.12. India : Fertilizer Industry

engineering, procurement and supervision of construction/commissioning of fertilizer and allied chemical plants. The company was declared as a sick company in December, 1992 and was closed down in April 2003.

9. Paradwip Phosphates Limited (PPL) was established in Dec. 1981 for setting up phosphatic fertilizer complex at Paradeep in Odisha. Phase I and II of this project went into commercial production in 1986 and 1992 respectively.

10. Brahmaputra Valley Fertilizer Corporation Limited (BVFCL) has been constituted into a new company from April 1, 2002 after hiving off the Namrup units of HFC. Units I and III of BVFCL have been commissioned in March 2002 after their revamp.

11. FCIL-Arawali Gypsum and Mineral India Limited (FAGMII) has been incorporated on February 14, 2003 after hiving off Jodhpur Mining Organising from FCI. Apart from taking over the Jodhpur Mining Organisation which is engaged in mining of Gypsum in four districts of the Rajasthan, the new company is engaged in mining other minerals in Rajasthan.

Cooperative Sector

Two organisations are very active in the cooperative sector. Indian Farmers Fertilizer Cooperative Limited (IFFCO) is a federation of over 24,000 cooperative societies. It was incorporated in November 1967 and has five operating units, one each at Kalol and Kandla in Gujarat and Phulpur and Phulpur Extension, and Aonla Extension in Uttar Pradesh. At present, IFFCO's installed annual capacity in terms of nutrients is 20.16 lakh metric tonnes of nitrogen and 8.25 lakh metric tonnes of phosphate. Krishak Bharati Cooperative Limited (KRIBHCO) was incorporated in 1985. It has a gas based urea-ammonia plant at Hazira in Gujarat with a capacity to produce 7.95 lakh metric tonnes in terms of nitrogen per annum.

Private Sector

A number of private companies are also engaged in manufacturing fertilizers. Some of the important companies are IEL (Kanpur), SRC (Kota), GNFC (Bharuch), Coromandel, (Vishakhapatnam), ZACL (Goa), EID Pary (Ennore), GSFC (Vadodara), SPIC (Tuticorin) and MFC (Mangalore). Their combined installed capacity is about 20 lakh tonnes per annum.

Imports

Although India is the third largest fertilizer producing country, she is also the third largest consumer of fertilizers in the world. There has always been a big gap between production and consumption of fertilizers in the country and the gap is widening with the passage of time. Even with a higher level of indigenous production, the gap between consumption and availability from indigenous sources increased considerably. **Table 25.17** shows the trends of fertilizer imports in India.

The table 25.17 shows that imports of fertilizers and fertilizer manufactures has increased tremendously during in last few years. India meets about half of the requirements of fertilizers through imports. However, strenuous efforts are being made to reduced undue dependence on imports.

India imports fertilizers from a large number of countries. The major suppliers of fertilizers to India are the USA, Russia, Canada, Japan and some European countries. A marginal fall in imports, both in terms of quantity and expenditure has been observed between 2011-12 and 2013-14.

CEMENT INDUSTRY

Cement is indispensible for building and construction work and cement industry is considered to be an important infrastructure core industry. It is one of the most advanced industries of India. In a developing country like India, the cement industry can play a significant role in the overall economic growth. The per capita consumption of cement is taken as one of the important indicators of well being of the people. The average per capita consumption of cement in India is 110 kg against the world average of 260 kg. This is much lower than some of the advanced countries and there is vast scope for improving the situation. India is currently on a fast track of economic growth and if the present growth trends continue, the per capita consumption is expected to touch 150 kg in 2020 even in the face of fast growing population.

TABLE 25.17. Imports of Fertilizers and Fertilizer Manufactures in India

Year	1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity (Thousand tonnes)	307	2,392.7	5,560.2	7,560.3	7,423.4	20,658.9	27,840.1	24,117.3	22,154.2
Value (₹ crore)	13	86	818	1,766	3,034	31,533	53,311	47,722	38,231

Source : The Economic Survey 2012-13, pp. A-84-86 and 2013-14, Statisical Appendix, pp. 71-73.

Locational Factors

Manufacturing of cement requires heavy, low value and weight loosing materials and is primarily a raw material oriented indsutry. Limestone is the main raw material and comprises 60-65 per cent of the total product by weight. On an average 1.5 tonnes of limestone are required to produce one tonne of cement. Hence, the location of a cement plant is based on the limestone deposits. The other raw materials used are sea shells, slag from steel plants and fertilizer plants and these raw materials influence the localisation of cement industry in their own way. Silica (20-25%) and alumina (5-12%) are also important ingredients. Gypsum is necessary to regulate the setting time of cement. Power is used in raw material grinding, clinkerisation of limestone in the kiln operation and clinker grinding along with gypsum to form cement. The older plants required 120 to 130 units of electricity per tonne of cement produced. Modern energy efficient plants consume only 80 to 90 units of electricity per tonne. Coal is another major input along with electricity and forms 40 per cent of the total cost. Coal is used not only as fuel in the kiln but also to burn the limestone. The ash of the burnt coal combines with the limestone to form clinker. On an average 250 kg of coal is required to produce one tonne of cement. The quantum of other materials required to produce one tonne of cement are 4 kg of gypsum, 0.4 kg of bauxite and 0.2 kg of clay.

Cement and its raw materials are low value bulk materials and the transportation over long distance by rails and roads involves huge costs. Some of the transportation cost on transporting limestone is reduced by beneficiating this mineral at the quarry heads. The transportation cost is also reduced if the manufacturing plant is located near the market. In fact ready market is the pre-requisite for the proper growth of an industry producing heavy commodity with low specific value like cement.

It is obvious from the above discussion that availability of raw materials, bulk transport facilities at reasonably low cost and market are the three main localisational factors, in that order, which favour the growth of cement industry in India.

Growth of Cement Industry

The first attempt to manufacture cement in India was made in 1904 when a mill based on sea shells as a source of limestone was established at Chennai. But this attempt proved abortive and a really successful attempt was made in 1912-13 when the Indian Cement Co. Ltd. set up a plant at Porbandar. World War I gave impetus to cement industry in India. Consequently, Katni Cement and Industrial Co. Ltd. at Katni (M.P.) started production in 1915 and Killick Nixon's Bundi Portland Cement Co. at Lakheri (Rajasthan) commenced in 1916. A number of companies came into existence to make use of the post war boom. Six new factories at Dwarka (Gujarat), Japla (Bihar), Banmore, Mehgaon, Kymore (M.P.) and Shahabad (Karnataka) were erected by 1922-23. Cement Production virtually took off the ground only after tarrif protection was granted to this industry in 1924. A turning point came in 1934 when 10 out of 11 existing companies merged into the Associated Cement Co. Ltd. (ACC). The Dalmia Cement Group was also formed in 1937. This group set up factories at Dalmianagar (Bihar), Dalmiapuram (Tamil Nadu) and Dalmia (Charkhi) Dadri in Haryana. By 1947, there were 18 cement factories with a capacity of 21.15 lakh tonnes and production of 20.16 lakh tonnes. Rapid economic progress associated with massive building programmes during the plan period accelerated the demand for cement and provided stimulus to this industry. India achieved self-sufficiency in cement only in 1980s during the short five year period of partial decontrol. Prior to that Indian cement industry had seen days of total controls, partial decontrols and imports. This industry was totally decontrolled in March, 1989 and it grew by leeps and bounds in 1990s. Today, in terms of quality, productivity and efficiency, the industry is second to none in the world. Its technology is state-of-the-art, its cost of production is one of the lowest in the world and its productivity is easily one of the highest.

Currently, the Indian cement industry is the second largest in the world after that of China. With a turnover of around ₹ 30,000 crore, the industry is the second biggest contributor to the exchequer. The Central government gets about ₹ 4,000 crore from excise duty and various state governments another ₹ 4,000 crore from sales tax, yet another ₹ 2,000 crore comes from royalties, octroi and cesses. The industry provides direct employment to 1.5 lakh persons and indirect employment to 1.2 million persons. The industry comprises 183 large cement plants with an installed capacity of 324.9 million tonnes and more than 350 mini plants with an estimated capacity of 11.10 million tonnes as on 31st March, 2013. These plants are scattered in almost all parts of the country. The mini plants play a supplementary role. The concept of mini plants was accepted by the Government in 1979 to exploit smaller deposits of limestone scattered in remote and inaccessible areas. This concept was supported by incentives like 50 per cent reduction in excise duty. The main advantage of mini cement plants is that they provide employment opportunities to rural and remote areas and make cement easily available there. Further, they help in dispersal of production capacity and reduce strain on transportation infrastructure. Over 60 companies are engaged in the production of cement. The industry has been going through a period of re-alignment or consolidated 1970s. The supply of cement in the open market was very scarce and building activity was badly hampered inflicting a severe blow to infrastructure development. The government took initiative to remove control on price and distribution of cement in 1989 and the industry was de-licensed in 1991 under the Industrial (Development and Regulation) Act, 1951. Since then, this industry has progressed at a fast rate both in capacity/production as well as in process technology. In due course of time, Indian cement industry has efficiently managed to keep pace with the global technological advancement. The induction of advanced technology has helped the industry immensely to improve its efficiency by conserving energy, fuel and addressing the environmental concerns.

There has been impressive growth in the installed capacity during the last few years and the momentum is likely to continue in the future also (**Table 25.18**).

The production of cement has increased considerably during the plan period. It increased from a low of 2.7 million tonnes in 1950-51 to 8.0 million tonnes in 1960-61, 1970-71, 48.8 million tonnes in 1999-91 and 223.5 million tonnes in 2011-12 (**Table 25.19**).

Given the enormous need for infrastructure and housing, which require large quantities of cement as a basic building material, the prospects of industry are bright. The Working Group on Cement Industry for the formulation of Tenth Five Year Plan and other studies on global competitiveness of the Indian cement industry highlight constraints such as high cost of power, high freight cost, inadequate infrastructure and poor quality of coal. In order to utilize the excess production capacity available with

TABLE 25.18. Installed capacity of Projection (in million tonnes)

Ending March	Base Line	Base line + Concrete Roads	Base Line + Roads + Housing	Base Line + Road + Housing + Fiscal support
2011	323.2	323.2	323.2	323.2
2012	336.1	336.1	336.1	336.1
2013	349.6	349.6	349.6	349.6
2014	363.1	369.8	373.2	374.9
2015	386.1	396.9	402.3	405.1
2016	413.3	428.7	436.6	440.6
2017	442.5	463.3	473.3	479.3

Source : India 2014, A Reference Annual, p. 491.

TABLE 25.19. Production of Cement in India (Million tonnes)

Year	1950 -51	1960 -61	1970 -71	1981 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12
Production	2.7	8.0	14.3	18.8	48.8	99.2	140.5	154.7	167.6	181.4	200.7	209.7	223.5

Source : Economic Survey 2012-130, p. A-32.

the cement industry, the Government has identified the following thrust areas for increasing demand :

- Further push to housing development programmes.
- Promotion of concrete highways.
- Use of ready-mix concrete in large infrastructure projects.
- Construction of concrete roads in rural areas under Prime Minister's Gram Sadak Yojana.

The Indian Cement industry today produces 11 varieties of cement including ordinary portland cement (71%), portland pozzolana cement (18%) and portland blast furnace slag cement (10%). The balance one per cent is of all special cements including white cement.

Distribution

A look at the distribution pattern of cement factories reveals that they are mainly concentrated along the Vindhayan ranges—running from eastern Rajasthan to Jharkhand—where abundant supply of good quality limestone is available. In fact limestone deposits have acted as big magnets for attracting cement factories and rarely a factory in this region is situated at a distance of over fifty kilometres from the limestone quarries. The vast northern plain, on the other hand, is devoid of limestone deposits and does not support cement factories to any appreicable extent. It is for this constraint of raw material that 86 per cent of the factories and 75 per cent of the production capacity is found in Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Rajasthan, Madhya Pradesh, Chhattisgarh, Gujarat, Tamil Nadu, Karnataka and Bihar.

Andhra Pradesh and Telangana. With 15 per cent of the total installed capacity and about 18 per cent of the total production of India, Andhra Pradesh along with Telangana occupy first place among the cement producing states of India. Most of the 21 plants are concentrated in the Telangana belt. The location of plants along the trunk rail route skirting the plateau along its junction with the coastal plain offers the best advantages with respect to raw material, market and transport. Peddapalli is the biggest plant with an installed annual capacity of 7 lakh tonnes. The other important producers are Krishna, Karimnagar, Cementnagar, Vijaywada, Panyon, Macherla, Mancherial, Tandur, Vishakhapatnam, Vizianagram, Nadikundi, Erranguntla, Yerranguntala, Adilabad, etc. Several mini plants are also functioning.

Rajasthan has surpassed Tamil Nadu and is now the second largest cement producing state accounting for over 13 per cent of India. The major cement plants skirt the Aravali Range where plenty of limestone is available. The large scale conversion of metre gauge railway lines into broad gauge has given the much needed improved transport facilities and stimulate cement industry in this region. The state has 10 major plants and the main centres of production are Sawai Madhopur, Lakheri, Chittaurgarh, Udaipur, Nimbaheda and Sirohi. With an annual capacity of 8.5 lakh tonnes, the plant at Sawai Madhopur is the largest in Rajasthan.

Madhya Pradesh. Madhya Pradesh is the third largest producer of cement in India after Andhra Pradesh (including Telangana) and Rajasthan. Its major production units are in the limestone rich districts of Satna, Katni, Rewa and Neemuch. These are located at Kaimur, Katni, and Bammore (Katni), Satno, Maihar (Satna), Vikramnagar (Neemuch), Kharadia (Dhar), Itarsi (Hoshangabad) and Damoh. This state supplies large quantities of cement to the neighbouring Uttar Pradesh.

Tamil Nadu. With an installed capacity of about 11 per cent of all India capacity, this state has 13 plants in different areas. Larger units are located at Talaiyuthu (Tirunelveli), Alangulam, Tulukapatti (Ramnathpuram), Dalmiapuram, Poliyur, Alathiyur (Tiruchirapalli), Sankaridurg (Salem) and Madukkarai (Coimbatore).

Gujarat. With an installed capacity of 13.93 million tonnes, Gujarat is the fourth largest cement producing state in India. This state had the advantage of an early start and the earliest successful attempt to manufacture cement was made at Porbandar. The industry enjoys the benefit of large deposits of limestone in the state. Besides, sea shells can also be used. Large market of Western India is readily available. Ten plants of the state are located at Sika, Sevolia, Okha, Porbandar, Dwarka, Vadodara, Ranavav, Veraval and Bhavnagar.

Maharashtra. Maharashtra is perhaps the largest cement consuming state in India due to on going

construction of a mega-structures like big malls, roads, bridges, etc. With an installed capacity of about 10.9 million tonnes, this state has its major cement factories at Chanderpur, Ratnagiri, Saweri, Mumbai, Battam and Kolhapur.

Karnataka. High quality cement grade limestone occurs in Bijapur, Gulburga, Chitradurga, Mysore, Simoga and Tumkur. The state has a total installed capacity of about 9.8 million tonnes. Bagalkot, Bhadravati, Shahabad, Ammasaudram, Wadi, Bengaluru and Krukunta are the main centres. The Shahabad unit is the largest and the only factory

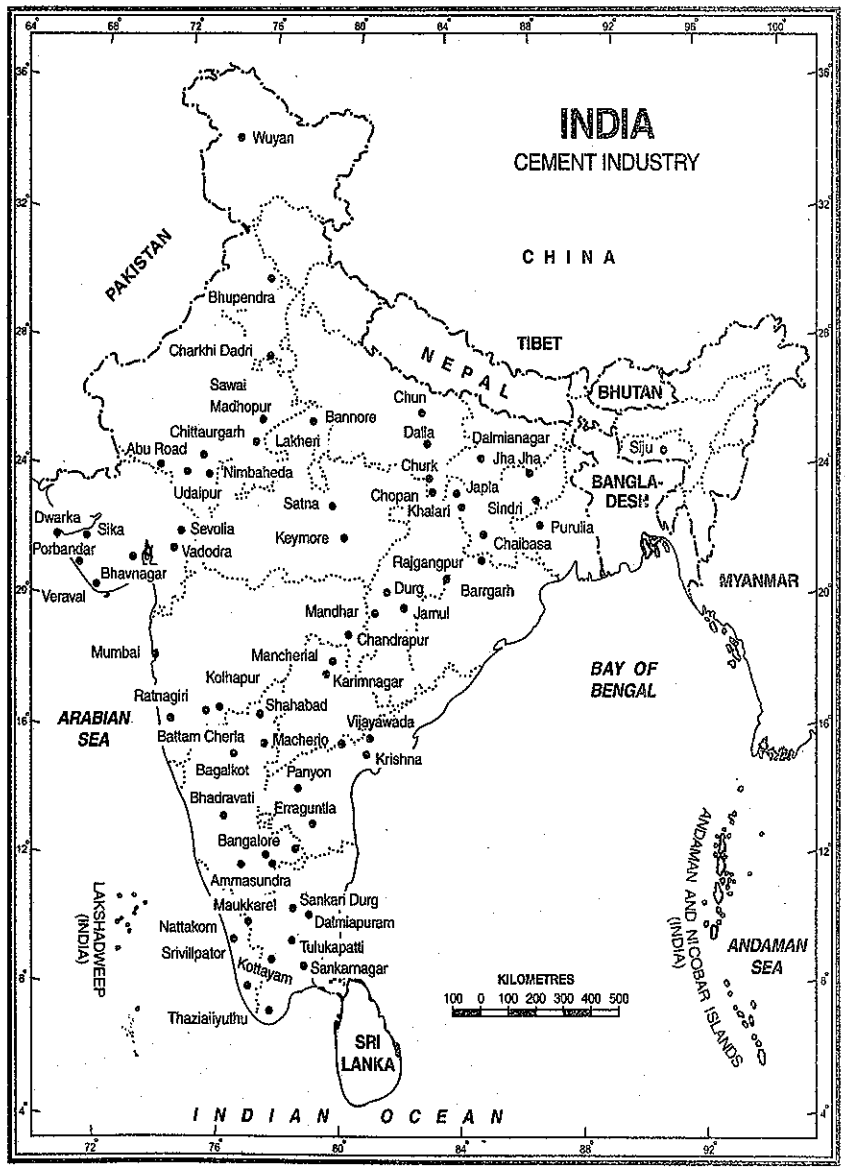


FIG. 25.13. India : Cement Industry

producing oil well cement in India currently. Two new units have come up at Hosdurga (Tumkur) and Tornagalu.

Chhattisgarh. This state has 6% of India's total limestone reserves and has an installed capacity of about 8.4 million tonnes. Chhattisgarh has 7 cement factories of which the larger ones are at Jamul (Durg), Mandhar and Modigram (Raipur), Lulli, Tilda and Akaltara (Bilaspur).

Jharkhand. Jharkhand has 5 cement plants with a total installed capacity of 5.9 million tonnes. Three plants are located at Sindri, Khalari (Ranchi), Bhavnathpur (Palam), Chhaibasa, Khodri and Jhikhani (West Singhbhum).

Uttar Pradesh. The main limestone deposits are found in the Upper Son Valley, where five cement manufacturing plants have been established. The major centres of production are Churk, Dalla, Chunar and Jhansi.

The other producers are Himachal Pradesh (Rajban in Sirmur district and Gagal in Bilaspur district), West Bengal (Durgapur, Purulia and Madhukunda), Odisha (Rajgangpur and Bargash), Haryana (Bhupendra), Bihar (Banjari, Japla and Chopan), Meghalaya (Cherrapunj and Garo), Nagaland (Waziho in Tunsang and Garampani), and Jammu and Kashmir (Basholi in Kathua district and Kharan in Baramula district).

Exports

From a net importer, India has emerged as a major exporter of cement in the international market. She entered the world cement scenario after 1989 when the production of cement increased considerably as a result of decontrolling the cement industry. The main buyers of Indian cement are Sri Lanka, Bangladesh, Myanmar, Indonesia, Malaysia, Nepal, Pakistan, Middle East countries and South-East Asian countries. The exports to these countries are likely to increase as they do not have appreciable deposits of limestone and cannot develop cement industry on their own.

Problems

Cement industry in India is facing a large number of problems. Some of the more serious problems are briefly described as under :

1. Inadequate Transport Facilities. The main raw materials (limestone, coal, gypsum, etc.) and the end product of cement industry are cheap and bulky and cannot afford high cost and inadequacy of transportation. It is estimated that transport of raw materials and furnished product accounts for 25-30 per cent of the total cost of cement manufacturing and supplies to the consuming areas. For example, cement plant at Sawai Modhopur in Rajasthan uses coal from Dhanbad mines in Jharkhand about 1,300 km away and supplies cement to consumers in Srinagar about 1,100 km away. Cement has short shelf life and should be dispatched to the consuming centres without any loss of time. All these factors require quick, cheap and efficient means of transportation for cement immediately after it comes out of the manufacturing plant. Earlier, railways used to be the main source of transporting cement but shortages of wagons, delays in transit and frequent increase in freight made this mode of transportation unattractive to the cement manufacturers. Consequently, a shift was noticed in favour of road transportation after 1989 and 60 per cent of the current needs of cement industry are met by the road transport.

2. Shortage of Coal. As mentioned at the outset, it requires about 250 kg of coal to produce one tonne of cement. Coal in India is always in short supply and most of the Indian coal varieties are of poor quality. Further, most of the coal reserves are concentrated in the north-eastern part of the peninsular plateau area and it becomes difficult to supply coal to areas located at large distances from the main coal producing region.

3. Shortage of Power. Currently, India is a power starved nation and the country is facing a serious power crisis. Although the consumption of power has come down from 120-130 units to 80-90 units per tonne of cement by using energy-efficient methods originating from the new technology, yet the industry is facing perpetual problem of power shortage. Load shedding and frequent declared and undeclared power cuts is a routine matter. This problem can be solved by increasing the power production.

4. Low Per Capita Consumption. Although there had been a spurt in the total consumption of cement in the country, the per capita consumption of cement in the country is still at a miserably low level.

TABLE 25.20. Production of tyres in India (in millions)

Year	1950 -51	1960 -61	1970 -71	1981 -81	1990 -91	2000 -01	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	2010 -11	2011 -12
Automobile tyres (truck/bus)*	NA	1.5	3.8	8.0	20.1	29.3	11.8	12.1	12.8	12.0	13.8	13.5	13.5
Cab/car tyres*	NA	NA	NA	NA	NA	NA	10.2	11.8	13.9	14.0	15.9	20.0	19.5

NA : Not Available. *New items/change in specifications, hence data prior to 2005-06 may not be comparable.

Source : Economic Survey, 2012-13, p. A-32.

Thus there is an overall shortage of demand for cement and the manufacturers do not get a ready market for their product. With new projects coming up very fast, it is hoped that there will be increase in consumption of cement and manufactures will not find it difficult to search for buyers of their product.

RUBBER GOODS INDUSTRY

Although nascent, rubber goods industry has emerged as an important industry in India. It covers a wide range of products such as tyres and tubes of all kinds, footwear, surgical gloves, prophylactics, conveyor and vee belts, hoses, instruments, sports goods, rubber coats and a host of other products.

The most important segment of rubber industry is constituted by tyres and tubes. At present, the industry has 32 tyre producing units spread over 13 states with about 220 medium scale units and over 5,500 units in the small scale sector, with an equal number in tiny sector having an annual turnover of over ₹ 12,000 crore. It directly employs about 3.5 lakh people. The number of automobile tyres (truck/bus) produced in 1960-61 was just 1.5 millions which rose to 13.5 millions in 2011-12. Similarly the number of car/cab tyres increased from 10.2 millions in 2005-06 to 19.5 millions in 2011-12 (**Table 25.20**)

India is one of the few countries which has a attained self sufficiency in manufacturing a wide range of tyres for all applications. Currently, Indian tyre industry consists of 39 companies with 60 tyres manufacturing plants. Large tyre companies are namely MRF Ltd., Apollo Tyres, JK Tyres, Ceat, Goodyear and Modi Rubber etc. Three Indian companies namely MRF Ltd., Apollo Tyres and JK Tyres are in the list of top 25 global tyre companies. The annual turnover of the tyre industry was about ₹ 46,000 crore during 2012-13. Indian tyre market is growing rapidly and in order to meet the growing demand, major tyre companies have taken up the new expansion projects. New tyre projects to the tune of ₹ 7,929 crore have been completed upto 2012-13 and projects involving investment of about ₹ 1,340 crore are under implementation which are likely to be completed during the remaining period of XII Five Year Plan.

India has become a major tyre exporting country and has a track record of exporting to over 75 countries. During 2012-13, India exported tyres worth ₹ 9,191.5 crore. India also imports tyres mainly from China and Thailand. During 2012-13 tyres worth ₹ 2,559.18 crore were imported.

Rubber footwear is another important item of rubber goods industry. Among the hoses, radiator and vacuum hoses are the most important. Fan belt is another important item.

LEATHER AND LEATHER GOODS

India has the largest number of livestock in the world and has an old tradition of processing leather and manufacturing leather goods. This industry has been carried on in India at the village level since Vedic times. The two major sectors of this industry are tanning and goods manufacturing.

Tanning

Tanning of hides and skins is an old and a very important sector of leather industry. Raw leather has to be tanned before use so that it can be given proper colour, strength and shine. The first tannery was set up at Kanpur in 1867. At present, Kanpur, Chennai and Kolkata are three large tanning centres in the country. The other important tanning centres are Agra, Bengaluru, Belgaum, Bhopal, Mokameh (Bihar), Phulbani (Odisha), Sherbaug (Gujarat),

Kapurthala (Punjab), Pallavaram, Trichirapalli, Perambur, Eluru, etc. Besides, there are about 300 small tanneries.

Tanning industry has become the target of severe criticism from environmentalists and several agencies because waste discharge from the tanneries has led to large-scale environmental pollution. This has called for the development and implementation of new and improved technologies for enabling the leather industry to comply with pollution control standards. The role of alternatives in the tanning sector is widely recognised. State-of-the-art technologies for leather chemicals and cleaner production are being developed and new technology is being absorbed at a rapid pace. Tanning without wasteful discharge of chromium, fashion dyed leather without the support of mineral tanning, reduction of salt, sulphide and many other environmentally disconcerting chemicals in tanning waste are now possible. The need of the hour is to adopt these technologies without any reservations and without further loss of time. The Central Leather Research Institute (CLRI) at Chennai is the largest of its kind in the world. It has developed a number of techniques for the benefit of the Indian leather industry.

The first meaningful intervention by the government in leather sector came in 1992 in the shape of United Nations Development Programme (UNDP) sponsored "National Leather Development Programme (NLDP)." During the Ninth Plan period Tannery Modernisation Scheme (TMS) was implemented successfully on pilot basis. A total number of 109 tanneries in SSI and Non-SSI sector were taken up for upgradation and modernisation of technology.

Leather Goods

India produces a large variety of leather goods including footwear, suitcases, bags and portfolios, ladies handbags, belts and several industrial accessories. However, footwear is the most important of all the leather goods and far excels others.

Manufacturing of footwear has been tradition bound and India is now one of the top ten producers of footwear in the world. Vast raw material resources, skilled manpower, developed expertise, low labour costs and foreign collaboration have given fillip to Indian footwear industry. After 1991, this industry witnessed profound changes as a result of liberalisation policy and due to globalisation of economy. Consequently, the production increased tremendously, both of the Indian style and the western style footwear.

The Indian footwear industry can be divided into three segments—large organised units, small scale sector and tiny cottage industry. Under large units come Bata, Carona and Tata, small scale units include Liberty, Wasan, Aero, Bajaj, Tej and Lakhani. Large scale units contribute 7-8 per cent of the exports while the bulk is provided by the small scale units. The tiny cottage units contribute the bulk of production and offer their products to the domestic market. The main centres of producing leather shoes, shoe uppers and leather sandals are Chennai, Ranipet, Ambur, Vaniambadi, Mumbai, Kolkata, Kanpur, Agra, Kolhapur, Delhi, Jalandhar, Bengaluru, Hyderabad, Batanagar, Faridabad and Jaipur.

Exports

India has been a traditional exporter of raw hides and skins. But the scenario has undergone much change and now India is emerging as a strong contender of leather goods exports in the world market. In 2011-12, leather and leather manufactures including leather footwear, leather travel goods and leather garments worth ₹ 22,973 crore were exported. The industry has identified major export markets in the U.S.A, Germany, U.K., France, Japan, Australia and Russia. With the adoption of new technologies, Indian leather goods would be able to meet the international standards and exports are expected to increase substantially.

PLASTICS

This industry made a humble beginning in 1945 but has registered a fast growth since then. The growth accelerated in the 1960s and with the liberalisation of Indian economy in 1991, it has shown tremendous growth and diversification and is now the star performer along with other fast growing industries like electronics, computers and white goods. Whereas the developed world has reported 3-4 per cent growth, the Indian plastic industry has reported double digit growth each year. It is now estimated that the plastic industry in India will grow at a rate of over 15 per cent per annum for several years to come.

The wonders of plastics cut across all sections of society. Due to its moulding capacity, its versatility, its non-corrosive and moisture resistant properties, its physical and chemical strength, its economic viability, its easy processability and also its attractiveness and durability in all weather conditions, it has become a material of choice and of universal use. The major uses of plastics are in the packaging industry, building industry and in the manufacturing of pipes, fittings, electrical accessories, consumer goods, houseware, toys, furniture and in host of other spheres of life. A time has come when plastics industry has the capacity to influence the progress of all other sectors. Plastic industry is regarded as '*sunrise*' industry due to its increasing versatility and burgeoning worldwide demand. *No wonder we are living in the plastic age.*

At present, the plastic industry produces goods from virgin and reprocessed polymer products. This sector provides employment to over 10 lakh skilled people directly and indirectly. That is why, the Governement has accorded it a *thrust industry status*. High growth in user segments such as retail packaging and building construction as well as in pipes, bulk packaging and agricultural use are expected to increase polymer demand tremendously making India the third largest polymer consumer after the USA and China. The low per capita polymer consumption is a pointer to the sector's immense growth potential. Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Vadodara, Vapi, Kanpur, Amritsar, Coimbatore, Bongaigaon, Barauni, Mettur, Durgapur, Pimpri (Pune), Rishra, etc. are some of the outstanding centres which are well known for the production of either plastic raw materials or finished plastic goods. The Government has set up the Central Institure of Plastics Engineering and Technology (CIPET) at Chennai with the primary objective to develop skilled manpower and provide tehnical services to the plastic industry. To meet the growing demand of trained personnel, CIPET has set up nine extension centres at Ahmedabad, Amritsar, Bhopal, Bhubaneshwar, Hyderabad, Imphal, Lucknow and Mysore including the headquarter centre at Chennai. A service centre and a training centre of CIPET have also been opened at Goa and Patna respectively.

Exports

Though exports of plastics from India is a recent development, the country has made a big dent in the international market. Kuwait, Saudi Arabia, Egypt, Kenya, Nigeria, Iraq, Syria, U.K., Thailand, Sri Lanka, and a number of other countries are the regular buyers of Indian plastic goods.

Prospects and Problems

The plastic goods industry in India has bright prospects and serious problems stored for it in the time to come. As mentioned earlier, the plastic goods have universal acceptability and their production and use will grow unhindered. The per capita consumption of plastics in India at 3.6 kg is far below the global average of 21.5 kg. Thus there is great scope for expanding this industry. There are tremendous investment opportunities in downstream investments to the tune of $ 3.7 billion at a compound annual growth rate of 11 per cent. The fructification of new investments is estimated to raise plastic consumption from the present level of 3.6 million tonnes to 20 million tonnes in 2020. This will create millions of unskilled and semi-skilled jobs and change the export profile from raw materials to value added plastic products. But the unprecedented growth in the use of plastics as a packing material has created a serious problem of solid waste disposal. Plastic is a non-biodegradable substance and creates problems of environmental pollution. Many advanced countries are seriously thinking of reverting back to conventional packing materials, thereby dealing big blow to this industry. However, Indian plastic industry may thrive on the recycling of the used plastic material for which ragpickers can make valuable contribution. Recycling solves the problem of waste disposal, lessens the burden on raw materials, lightens the pressure on the biosphere and provides jobs to millions. It may be mentioned here that this process needs technological development and upgradation.

DRUGS AND PHARMACEUTICALS

The growth of drugs and pharmaceutical industry in India is primarily a post-Independence phenomenon. Before Independence, bulk of drugs were imported and only processing and formulations were done in

the country. This industry has made tremendous progress during the last 50 years. The growth rate of this industry has been about ten per cent per annum, consistently for the last more than three decades. Today, India is in a position to meet 95 per cent of her requirements of bulk drugs and almost all the requirement of formulations. The present production covers a wide range of bulk drugs including antibiotics, vitamins, steroids and hormones, semi-synthetic penicillins, synthetic phytochemicals and biological products besides, practically the entire range of formulations required by the medical profession.

The industry is likely to grow rapidly in times to come.

Drug prices in India are some of the lowest in the world and India has one of the largest inventories of highly skilled pharmaceutical professionals. Modern drugs reach only 40 per cent of Indian population mainly in urban and semi-urban areas. Obviously the potential for growth in the domestic market is enormous.

There are about 250 units in the organised sector, five of these in the public sector (IDPL, HAL, SSPL, BCPL and BIL) and six in the joint sector. There are 21 MRTP companies and six FERA ones. About 5,000 units in the small scale sector are also engaged in the production of drugs. Of these, over 100 units are engaged in the production of bulk drugs.

Indian Drugs and Pharmaceuticals Limited (IDPL) a premier undertaking was incorporated on 5 April 1961. It has five plants located at Rishikesh for the manufacture of synthetic drugs, at Chennai for surgical instruments, at Gurgaon for formulations, Hyderabad (synthetic drugs plant) and at Muzaffarpur for drugs and chemical intermediates. Besides, IDPL has three subsidiary companies set up in association with the state governments. These are Rajasthan Drugs and Pharamaceuticals (RDPL), Jaipur, Uttar Pradesh Drugs and Pharmaceuticals Ltd. (UPDPL), Lucknow and Odisha Drugs and Chemicals Ltd. (ODCL), Bhubaneshwar.

Hindustan Antibiotics Limited (HAL) was incorporated on 1 March 1954. It is engaged in manufacturing Penicillin, Streptomycin, Amcillin, Hamycin, Gentamycin and Aureofungen, besides formulations. It has three subsidiary companies set up in collaboration with the state governments. They are (*i*) Maharashtra Antibiotics and Pharamceutical Limited (MAPL), Nagpur, (*ii*) Karnataka Antibiotics and Pharmaceuticals Limited (KAPL), Bengaluru and (*iii*) Manipur State Drugs and Pharmaceuticals Limited (MSDPL) Imphal.

The Government has also nationalised three sick units at Kolkata. These units have been converted into public sector companies. They are (*i*) Bengal Immunity Limited (BIL), (*ii*) Bengal Chemicals and Pharmaceuticals Limited (BCPL) and (*iii*) Smith Stanistreet Pharmaceuticals Ltd. (SSPL)

The leading companies in the private sector are Ciba, Sarabhai, Hoechst, Alembic, Glaxo, Unichem, Pfizer, Chemo Pharma and Warner Hindustan. These companies produce almost all types of drugs and formualtions.

Although small sector units are scattered all over the country, their heavier concentration is found at Mumbai, Chennai, Kolkata, Delhi, Vadodara, Kanpur and Hyderabad.

Pesticides. The importance of pesticides (which include insecticides, fungicides and rodenticides, etc.) in agriculture and public health, has led to a steady growth of pesticide industry in India. At present, more than 125 units are engaged in the manufacture of technical grade pesticides and over 500 units are making pesticides formulations. The Hindustan Insecticide Ltd. (HIL) is a public sector undertaking engaged in manufacturing of insecticides. It has three units, *viz*., Udyogmandal (Kerala), Rasayani (Maharashtra) and Delhi. Its subsidiary company, Southern Pesticide Corporation (SPC) has a factory at Kovur. The Hindustan Insecticide Ltd. produces BHC, DDT, Malathion and Endosulfan which are widely used in India.

India's installed capacity is 1.25 lakh tonnes while the total annual production is 85,800 tonnes. India used to import large quantities of pesticides but because of technical upgradation and increase in production, the imports have been drastically reduced. On the other hand, India is now in a position to export pesticides.

DYESTUFFS

The dyestuff industry represents the highest development of chemical technology and forms an important link in the chain of other essential chemical industries. Although natural and vegetable colours have been used in India for centuries, the use of synthetic organic dyestuffs is largely a post World War II phenomenon. The need for indigenous dyestuffs was felt during World War II when the import of dyes practically ceased. The first organised dyestuff unit in India was Associated Research Laboratories (Now Arlab Ltd.) established in 1941 near Pune. Atul Products was set up in 1947 near Bulsar. The production commenced in 1952. This was followed by Amar Dyechem and Indian Dyestuff Industries in 1954. A number of companies with foreign collaboration also made their presence felt. Outstanding among them were Alic Industries in 1956 (ICI and Atul), Suhrid Geigy (Sarabhais and Geigy), Colurchem (Bayer, Hoechst and Ghais) and Sandoz (India) at Kolshet in 1961. Thus, by the 1960s, the stage was well set for rapid growth of the indsutry. Today, the industry produces a large variety of dyestuffs in sufficient quantity and is able to meet over 95 per cent of the demands for dyestuffs in the country. There are now 50 units in organised sector accounting for 65 per cent of the total production. The remaining 35 per cent is contributed by over 1,000 small scale units. The greatest concentration of this industry is in the two western states of Maharashtra and Gujarat and these two states together account for over 90 per cent of the dyestuff production in the country.

The dyestuff industry in India has some inherent strength, as a result of which it has shown rapid progress. The main users are the textile and the leather goods industries which are themselves growing very fast, thereby creating a large domestic market for dyestuffs. Increasing availabiity of basic feedstock, a matured chemical engineering industry, availability of skilled labour, trained supervisory and plant personnel, high degree of entrepreneurship and low overhead costs are added advantages enjoyed by this industry. Thus it can safely be predicted that this industry will grow at still faster rate in future. From a humble beginning, India is now in a position to export a large variety of dyestuffs.

SOAPS AND DETERGENTS

Soap industry started developing immediately after World War I and detergents followed it later on. The total current market of soaps and detergents is valued at ₹ 6,716 crore. The market can be classified into toilet soaps for personal wash and non-soap detergent (NSD) bars and powders and laundry soaps for washing cloth. The personal wash market is valued at ₹ 2,690 crore. The NSD bar and powder market is much bigger and is worth ₹ 3,037 crore. The laundry soap market is dominated by the small sector. This is estimated to be about ₹ 589 crore, whereas the personal wash market and fabric wash market is growing at the rate of 3-4 per cent per annum, laundry soap market is almost stagnant. It is worth mentioning that the rural market for soaps and detergents is more buoyant than the urban market.

Eighty eight units in the organised sector have a capacity of manufacturing 7,05,963 tonnes of soap per year. Thirty three units in the organised sector are busy in manufacturing synthetic detergents. They house a total installed capacity of 6,05,000 tonnes per year.

GLASS INDUSTRY

Indians are known to have acquired the knowledge of making glass since time immemorial. Glass industry came into being in India in 16th century when items like bangles, small bottles and flasks were made. By 17th century, enamalled glass was produced at a number of places in Karnataka and Uttar Pradesh. Although glass industry on modern lines was started in the 19th century, the real growth started only after 1932. The first successful organised glass factory was set up in 1941. The industry underwent large scale modernisation after Independence. At present, India is a major producer of glass and glass products. The production of bottle/bottle glassware was 12,48,075 tonnes during 2012-13.

Localisation

Glass industry requires a large number of raw materials. The most important raw material is silica sand which constitutes 75 per cent of the basic materials. This is a bulky material and cannot bear high transportation cost. Obviously the availability of silica sand influences the localisation of glass industry. The other raw materials used for manufacturing glass are soda ash, feldspar, limestone, dolomite, manganese dioxide, barium oxide, sulphur and copper. These raw materials affect the

localisation of glass industry to some extent in their own way. All these raw materials except soda ash are abundantly available in the country. Sufficient supply of coal at cheap rates also influence this industry. But glass is a fragile commodity and easily breaks during transit. Therefore, this industry tends to be located near the market.

Distribution

Uttar Pradesh, West Bengal, Maharashtra and Tamil Nadu are the main glass producing states and contribute the bulk of production.

Uttar Pradesh. Firozabad in Agra district is the largest producer having as many as 100 small factories. The other major centres of glass production are Bahjoi, Naini, Hiranagau, Shikohabad, Hathras, Sasni, Allahabad and Jaunpur. Uttar Pradesh has the advantage of locally available raw materials and a ready market for glass and glass products. Skilled glass workers known as ***shisgars*** of Firozabad have been engaged in the process of glass making for several generations and provide cheap and skilled labour for this purpose. Only coal has to be transported from Jharkhand and West Bengal.

West Bengal. The state has 34 factories located at different places like Kolkata, Haora, Raniganj, Belgachiya, Belgharia, Belur, Sitarampur, Rishra, Durgapur and Asansol. Pure sand of high quality is available from the white Damudas sandstones at Mangalhat and Patharghata. Sand is also obtained from Bargarh and Lohagra near Allahabad. Good quality coal is obtained from the nearby coalfields at Jharia and Raniganj. Good market is readily available in the Hugli industrial region.

Maharashtra. The state has 22 factories. Main centres of galss industry are Mumbai, Talegaon (Pune), Satara, Nagpur and Kolhapur. The industry specializes in bottles, shells, flasks, lampware, beakers and sheet glass.

The other producers are *Gujarat* (Bharuch, Vadodara, Morvi and Panchmahal), *Tamil Nadu* (Salem, Chennai, Coimbatore), *Bihar* (Bhawaninagar, Patna), *Jharkhand* (Kandra, Jamshedpur, Kahalgaon), *Rajasthan* (Dhaulpur and Jaipur), *Haryana* (Ambala and Faridabad), *Telangana* (Warrangal and Hyderabad), *Delhi* (Shahdara), *Punjab* (Amritsar), *Kerala* (Alwaye), *Odisha* (Barang, Cuttack), *Madhya Pradesh* (Jabalpur, Gondia), *Assam* (Guwahati) and *Karnataka* (Bengaluru).

The export and import of glass and glassware during 2011-12 was worth ₹ 2,555.92 crores and ₹ 3,381.78 crores respectively.

CERAMICS INDUSTRY

It is a very old industry and dates back to about 5000 years B.C. The excavations of Harappa and Mohen-jo-Daro have revealed that a wide variety of pottery goods and ceramics of different designs and colours was used when the Indus Valley civilisation was at its peak. The beginning of modern ceramics industry is associated with the discovery of deposits of China clay in Rajmahal hills in Jharkhand. The first ceramic factory was established at Patharghatta in 1860. In the same year, Burn and Co. set up a factory at Raniganj in West Bengal and the production of glazed tiles commenced. Further discoveries of China clay in different parts of the country added new dimensions to ceramic industry and a number of factories came up in West Bengal, Bihar, Madhya Pradesh, Maharashtra, Gujarat, Karnataka and Kerala. World War II gave further impetus to this industry because metallic utensils could not be made due to ban on the import of metals. The industry has made rapid strides in the post-Independence era.

Today, ceramic industry produces a wide range of products, the outstanding being sanitary wares, porcelain wares, stoneware, enamel ware, tiles, crockery, insulators, etc. These products are used for a variety of purposes such as generation and transmission of power, construction of modern buildings, engineering, electronics, etc.

At present, there are above 150 units in the organised sector manufacturing different items. The important centres are Kolkata, Mumbai, Bengaluru, Delhi, Wankaner, Thanagarh, Ranipet, Rupnarainpur, Jabalpur, Nazarbagh, Gwalior, Jaipur, etc.

Indian ceramic products are some of the best so far as their quality, shape, design and colour are concerned and are easily accepted in the international market. The main buyers of Indian ceramic goods are Iran, Iraq, Saudi Arabia, Kuwait, Kenya, Uganda, Tanzania, Zambia, Sudan, Mauritius, Sri Lanka, Myanmar, etc. India also imports ceramic products from some Asian and European countries like China, Japan, U.K., Germany, the Netherlands, Czech Republic and Slovakia.

FOREST BASED INDUSTRIES

Forests provide us with different types of materials which are used as raw materials for certain industries. Those industries which use forest products as raw materials are called forest based industries. Paper, match, lac, sports goods, plywood, etc. are such industries.

PAPER INDUSTRY

Paper is one of the core industries and is linked to the basic human needs. Paper is the pre-requisite for education and literacy and its use is an index of advancement in these two fields as well as the overall well being of the society.

This is the most important of all the forest based industries. Some people treat it as a chemical industry due to its manufacturing process and because of certain chemicals used for its manufacturing. Still some other people include it in the group of agro-based industries because some of the agricultural products and residuals are used as raw materials. As large proportion of the basic raw materials is derived from the forests, it seems logical to treat it as a forest based industry.

Growth and Development

Paper manufacturing has been carried on in India since tenth century as a small cottage industry by the traditional craftsmen called ***kagzis***. They used gunny bags, rags, ropes, etc. for making paper. This industry could not survive the onslaught of the machine made paper and declined considerably. However, a part of it has managed to survive and even today, a large number of small units are producing handmade paper.

The beginning of modern paper industry goes back to 1816 when a factory was set up near Chennai. This venture proved abortive. Another papermill was set up in 1832 at Serampore on the bank of Hugli in West Bengal. This venture also failed and the first successful effort was made in 1870 with the setting up of the Royal Bengal Paper mills at Ballyganj near Kolkata. This is the principal seat of paper industry even today. Subsequent successful efforts were made at Lucknow in 1879, Titagarh in 1882, Pune in 1887, Raniganj in 1892, Kaukinra in 1892 and Naihati in 1918. The preferential treatment and tariff protection helped in solving the initial problems of this industry. World War II further infused life into this industry. But the progress was rather sluggish till Independence and it is only in the plan period that the industry has really made fast progress. The growing knowledge base coupled with synergistic contributions from flagship schemes of the government, namely Sarva Shiksha Abhiyan and Right is Education assured a robust demand for paper and paper board. The industry was de-licensed in July 1997. As per present policy FDI upto 100 per cent is allowed on automatic route for pulp and paper sector. In the year 1950-51 there were only 17 mills with a total installed capacity of 1.37 lakh tonnes. In 2012-13, the number of units manufacturing pulp, paper, paper board and newsprint was 759, out of which 652 were in operation. The total installed capacity was 12.7 million tonnes out of which nearly 1.37 million tonnes were lying idle due to closure of 107 units, mostly due to pollution problems. Thus the total operating capacity is around 11.33 million tonnes. The Indian paper industry is in a fragmented structure, consisting of small, medium and large paper mills having capacity ranging from 5 to 1,270 tonnes per day.

TABLE 25.21. Performance of Paper Industry in India (2012-13)

Type of mills	Scale of operation (Tonnes per day)	No. of mills	Percentage share in operating installed capacity
Large mills	100-1100	119	36
Medium mills	50-100	117	29
Small Mills	5-50	523	35
Total	—	759	100

Source : India 2014, A Reference Annual, p. 494.

The production of paper and paper board stood at 11.8 million tonnes in 2012-13. Trends in production of different types of paper are shown in table 25.22.

The industry in India is ranked among 15 top global paper industries. Its turnover is about ₹ 16,000 crore, employing nearly three lakh people directly and 10 lakh people indirectly. The per capita consumption

of paper in India is still at 5.5 kg, which is far below the global average of nearly 50 kg.

TABLE 25.22. Production of paper in India

Year	Corrugated and other paper (₹ crore)	Craft Paper (Thousand tonnes)	Writing and printing paper (Thousand tonnes)
2005-06	270	899	1,974
2006-07	261	977	2,066
2007-08	214	1,014	2,144
2008-09	223	1,060	2,288
2009-10	226	1,184	2,387
2010-11	269	1,260	2,577
2011-12	259	1,263	2,867

Source : Economic Survey, 2012-13, p. A-32.

Raw Materials. Paper and paper board can be manufactured by using different types of raw materials. Raw materials account for 45-50 per cent of the total cost of production and form an important segment of manufacturing paper and paper board. Of the total installed capacity, 43 per cent is dependent on forest based raw materials, 28 per cent on agro based raw materials and the remaining 29 per cent on other materials including waste paper.

Bamboo. Generally speaking 2.3 to 2.4 tonnes of bamboo is required for producing one tonne of paper. The paper industry uses bamboo to the extent of 60-70 per cent of the total requirements of cellulosic raw materials. Bamboo has the advantage of the possessing long fibre, dense stands and quick regeneration. It reaches maturity in 2-3 years and provides continuous flow of renewable source of raw material. However, there is danger of this source of important raw material being depleted if the rate of exploitation exceeds the rate of regeneration. The total supply of bamboo at the current rate is estimated at 20-30 lakh tonnes per annum. Assam, Odisha, Andhra Pradesh, Telangana Madhya Pradesh, Tamil Nadu, Karnataka and Maharashtra are important producers of bamboo.

Sabai Grass. This is another important raw material for manufacturing paper. It was the sole raw material before introduction of bamboo as a significant raw material, but its use has decreased considerably since then. It now constitutes 7 to 9 per cent of the total cellulosic raw material in the country. Although sabai grass has long fibre and requires low chemical consumption, it grows in tufts intermixed with other vegetation and it is often difficult to separate impurities from it. Moreover, its supplies are much less than those of bamboo. The annual supply of sabai grass along with other allied grasses is about one million tonnes. It mainly grows in the sub-Himalayan tracts of Shiwaliks and Tarai area.

Bagasse. It is a fibrous residue of the sugarcane stalk, mainly from the sugar mills, obtained after sucrose is extracted by crushing the sugarcane. On an average 50-60 lakh tonnes of bagasse is produced in the country, half of which is used for manufacturing paper.

Other materials. Paper is also manufactured by using materials other than those mentioned above. These include waste paper, rags, straw from rice and wheat, jute sticks and soft wood obtained from eucalyptus, pine-wood, wattle and mulberry trees.

Chemicals. In addition to the above mentioned cellulosic raw materials, certain chemicals are also used in the manufacture of pulp, paper and paper board. The important chemicals are caustic soda, soda ash, sodium sulphate, chlorine, sulphuric acid, sulphur, lime, ferric alumina, ammonium sulphate, resin and clay. A variety of sizing and colouring agents are also used. Coal is also an important input in paper industry. Normally, 3.5 to 4.1 tonnes of coal is required for producing one tonne of paper. Large quantity of soft water is also needed.

Localisation of the Industry

Paper and paper board manufacturing uses coarse, cheap and weight losing raw materials and seeks raw material oriented locations. Chemicals used in this industry are needed in small quantity and are easily transported even over long distances from the place of production to the place of consumption. Therefore, there is a strong tendency among the paper mills to be located near the forest tracts along the Western Ghats, the Eastern Ghats, central India and the Tarai-Bhabar area at the foot hills of the Himalayas. There are vast stands of temperate forests in the Himalayan region which can provide large quantities of soft woods. These soft woods can provide excellent cellulosic material for the paper industry. But because of the rugged terrain and poor means of transportation, these areas are inaccessible and the possibility of extraction of these soft woods and their supply to paper mills in the adjoining areas is remote. Moreover, the regeneration of wood pulp forests takes about 50-60 years, while bamboo forest is ready within 2-3 years. So far, no paper mill has been set up in the Himalayan region. Since the supply of cellulosic raw materials falls short of the demands of the paper industry, efforts are being made to bring more land under plantation of eucalyptus and other fast growing soft wood trees. However, plantations of eucalyptus has been discouraged during the last couple of decades in eastern parts of the country because this tree quickly exhausts the sub-soil water in large quantities. Some of the paper mills are located near the market where cheap labour is also available.

Distribution of Paper Industry

Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh and West Bengal are the main producers and account for more than half of the paper and paper board production of India.

Maharashtra. Maharashtra has risen from fourth position in the mid-1980s to second position in 1993 and to first position in 1996 among the major paper producing states of India. The state has 63 mills, accounts for 16.52 per cent of the installed capacity and produces 18 per cent of the paper produced in India. Maharashtra is not very lucky with respect to the availability of raw material and coal. Most of the mills located in Maharashtra use rags, waste paper or pulp imported from Sweden and Canada as the principal cellulosic raw material. Hydroelectricity is used as a power resource in place of coal. Ballarpur has the largest paper mill. Sangli, Kalyan, Mumbai, Pune, Balarshah, Pimpri, Nagpur, Bhiwandi, Nandurbar, Tumur, Khopoli, Kamptee, Vikroli, Chinchwad, etc. are other major producers.

Andhra Pradesh. Although a late entrant in paper industry, Andhra Pradesh superceded West Bengal in early 1990s to become the top producer but conceded this position to Maharashtra in mid-1990s. At present, this state has 19 mills, accounts for 11.3 per cent of installed capacity and 13 per cent of India's total production of paper. Paper mills are mainly located at Rajahmundry, Tirupati, Kurnool, Srikakulum, Pallancheru, Nellore Bhadrachalam, Kakinada, Apidik, Bodhan, etc. Most of the mills use bamboo as the basic raw material. Bamboo grows widely in Andhra Pradesh and the recoverable reserves are estimated to be about 1.5 lakh tonnes per annum.

Telangana. In the neighbouring Telangana, Sirpur (Kagaznagar) is the most important centre of paper manufacturing. Sarapaka, Khammam are the other important centres of manufacturing paper.

Gujarat. Gujarat has improved its position considerably in paper manufacture. The share of Gujarat in the nation's total production of paper has gone up from a miserable 3 per cent in the mid-1980s to a respectable 10 per cent in the mid-1990s. The state has as many as 55 mills which largely depend upon bagasse and eucalyptus for supply of raw material. The main centres of production are Rajkot, Vadodara, Surat, Barjod, Bilmoria, Navsari, Songarh, Ahmedabad, Vapi, Bharuch, Dijandranagar, Limbdi, Gondal, Udvada and Bavla.

Uttar Pradesh. This state has the largest number of 68 mills, but the size of the mills being small, the installed capacity does not exceed 9 per cent. Saharanpur and Lalkuan have mills of large size. The other centres are at Meerut, Modinagar, Ghaziabad, Lucknow, Gorakhpur, Pipraich, Muzaffarnagar, Allahabad (Naini), Varanasi, Kalpi, Budaun and Mainpuri.

West Bengal. West Bengal was the pioneer state in the paper industry at the initial stage and led the country till mid-1980s. The state has since slided down the ladder to fifth place with 22 mills, 7 per cent of the installed capacity and about the same percentage of production. West Bengal has the advantage of early start of this industry. The paper industry in West Bengal is based on bamboo which is available locally or is obtained from Assam, Odisha and Jharkhand, and sabai grass which is obtained from Chhattisgarh and Madhya Pradesh. Coal is abundantly available from Jharia and Raniganj. Ganga and other rivers provide sufficient water for processing. High density of population provides cheap labour. The highest concentration of paper mills is found along the Hugli river. Titagarh, Kankinara, Raniganj, Bansberia, Sheoraphuli, Chandrabati, Triveni, Naihati, Kolkata and Baranagore are some of the important centres of paper manufacturing in West Bengal.

Madhya Pradesh. Madhya Pradesh has large tracts under cellulosic raw materials *viz.*, bamboo, sabai grass, eucalyptus, etc. and provides solid base to paper industry. The state has 18 mills which account for 6.62 per cent of the total installed capacity of India. The main centres of production are Bhopal, Amla, (Shahdol), Ratlam, Rajgarh, Vidisha, Abdullaganj, Rewa and Indore. Nepanagar is the birthplace of newsprint industry and is still an important centre of newsprint manufacturing in India.

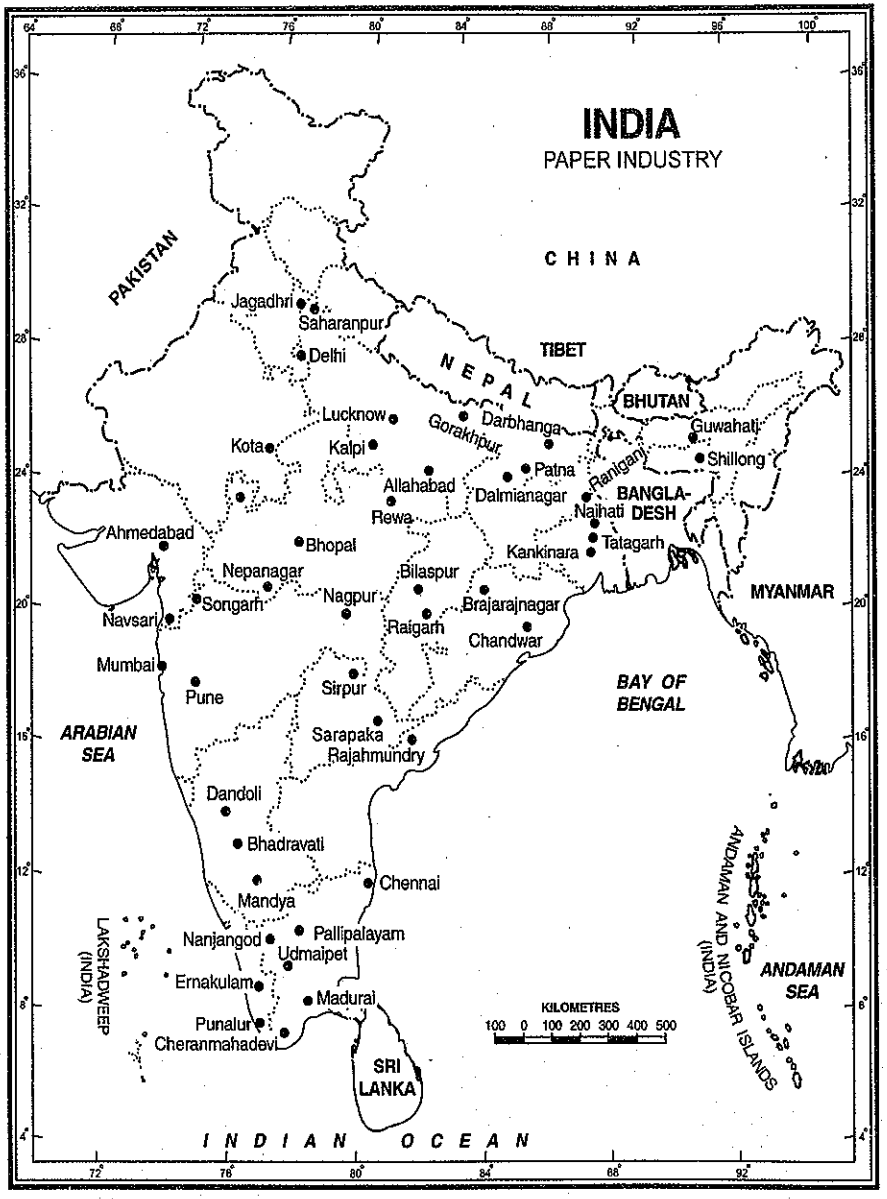


FIG. 25.14. India : Paper Industry

Odisha. The paper mills of Odisha make use of bamboo which covers large areas in the Eastern Ghats. The average annual production of bamboo is about five lakh tonnes. The state has only 8 mills but their size is sufficiently large enabling the state to account for over six per cent of the total capacity. However, with the dwindling supply of bamboo, the state's relative position has declined over the years. Brijrajnagar, Chandwar, Raygada are the main centres of production.

Tamil Nadu. Tamil Nadu has 24 small sized mills accounting for 5.74 per cent of the total installed capacity of the country. These mills use locally grown bamboo. Cheranmahadevi, Pallipalayam, Udmalpet, Chennai, Salem, Amravathinagar, Pahanasam, Madurai, etc. are the major producers.

Karnataka. Paper mills in Karanataka use locally grown bamboo and bagasse obtained from the sugar mills. Karnataka has 17 mills accounting for 5.48 per cent of the total capacity of India. The main cocentration is found at Bhadravati, Dandoli, Nandangaud, Belagola, Munirabad, Harihar, Mundyud, Bengaluru, Mandya, Ramnagaram and Krishnarajsagar.

Punjab. Punjab has 23 mills but their size is small as compared to those of Karnataka and their installed capacity is a little over five per cent of the total capacity of India. Most of the mills have capacities varying from 10 to 20 thousand tonnes. Hoshiarpur, Sangrur, Sailakhurd and Rajpura are the chief producing centres.

Assam. Assam has large areas under bamboo growth and supplies bamboo to neighbouring states, like West Bengal after meeting its own requirements. Nowgaon has one of the largest paper mills of India. The other producing centres are Guwahati, Cachar and Lumding.

Haryana. Haryana's 18 mills mainly depend upon imported pulp and eucalyptus wood as raw material. Yamunanagar has the largest mill. Small units are functioning at Faridabad, Dharuhera and Jagadhari.

Others. Bihar has 6 mills with a total installed capacity of 87.6 thousand tonnes. Dalmianagar, Patna, Darbhanga, Samastipur, Barauni are the chief producers. **Himachal Pradesh** also has 6 small units. Borokwala and Kala Amb are the main centres. **Kerala** (Punalur, Ernakulam, Mavoor, Rayanpuram and Kozhikode), **Rajasthan** (Kota), **Meghalaya** (Shillong), **Nagaland** (Mokekchong) also produce paper.

Newsprint. The production of newsprint in India commenced with the establishment of National Newsprint and Paper Mills known as NEPA in 1955 at Nepanagar in Hoshangabad district of M.P. Its initial capacity was 30 thousand tonnes which has now been raised to 75 thousand tonnes.This mill remained as the sole newsprint producer in the country till 1980. Mysore Paper mills, at Shimoga in Karnataka (capacity 75,000 tonnes) started production in 1981. The Hindustan Newsprint at Vellore near Kottayam in Kerala (capcity 80,000 tonnes) started producing in 1982. This was followed by commencement of production in 1985 by Tamil Nadu Newsprint and Paper Ltd. at Pugalur in Tiruchirapalli with a capacity of 50,000 tonnes. The newsprint sector in the country is governed by the Newsprint Control Order (NCO) 2004. The mills listed under the schedule of this order are exempt from excise duty, subject to actual user condition. At present there are 117 mills registered out of which only 73 are producing newsprint making in installed capacity of 1.3 million tonnes per annum.

Foreign Trade

Inspite of the phenomenal progress made by the paper industry in India, the production of paper, paper board and above all newsprint has always fallen short of the demand. This has forced the country to resort to heavy imports to meet the growing demand in the domestic market and put a check on the rising price of paper and paper products. The present rate of consumption of about 5.5 kg per capita per annum is extremely low as compared to the world average of 50 kg and over 300 kg of the highly advanced countries. A little increase in the capita consumption can lead to serious crisis of paper availability in the coming years.

Table 25.23 shows that the amount spent on the import of raw materials, like pulp and waste paper as well as that of finished paper, paper board and manufactures thereof has been rising at an alarming rate.

TABLE 25.23. Import of Paper, Paper Board and Raw Materials

Year	Paper, paper board and manufactures thereof		Pulp and waste paper	
	Quantity ('000 tonnes)	Value (₹ crore)	Quantity ('000 tonnes)	Value (₹ crore)
1960-61	55.6	12	80.3	7
1970-71	159.0	25	71.7	12
1980-81	371.4	187	36.9	18
1990-91	286.4	456	678.2	458
2000-01	585.6	2,005	1,050.9	1,290
2010-11	2,145.0	9,614	2,634.5	5,208
2011-12	2,586.0	12,305	3,215.9	6,524
2012-13	2,593.7	12,947	3,294.7	6,991
2013-14	2,761.3	15,067	36,484.8	8,378

Source : Economic Survey 2013-14, Statistical Appendix, pp. 71-73.

The position with regard to newsprint is still worse. The current per capita consumption of newsprint in India is too meagre 600 grams as compared to the Asian (excluding Japan and China) average of 1.9 kg and the world average of 6 kg. Consumption is forecast to grow to one kg by 2020 A.D.

Pulp and waste paper are imported from Norway, Sweden, Canada and Holland and the main sources of paper, paper board and newsprint are Sweden, Poland, Canada, Czech Republic and Slovakia.

Problems and Prospects

Paper industry in India faces many serious problems and prospects do not seem very bright. The biggest problem faced by this industry is the scarcity of raw materials. Most of the materials used for manufacturing paper are derived from the forests. With the increasing degradation of forest and fast depletion of forest based raw materials, like bamboo, the paper industry is facing a severe raw material crisis. With the exploitation of forests based raw materials reaching its saturation, any substantial capacity expansion in the near future is practically ruled out and the growth of industry has come to a standstill. In order to survive and expand, the industry will have to look for unconventional raw materials. This will require new advanced technology which a developing country like India may not be able to afford.

Another alternative is to increase the use of waste paper which will reduce dependence on the conventional raw materials. This will also reduce cost of energy used and other inputs. It may be mentioned here that only 15 per cent of the total output of paper and paper board is based on recycled material against the world average of 30-35 per cent. Thus there is a vast scope for using recycled material in paper industry.

Even now, large quantities of bagasse is just used as fuel in the sugar industry and is not made available to paper industry. If the sugar mills are encouraged to use coal fired boilers instead of those based on bagasse, this precious raw material can solve the problem of paper industry to great extent.

The growing consciousness for preservation of forests and maintenance of ecological balance and biodiversity during the last few years is further reducing the availability of raw materials to this industry. Environmentalists are also up in the arms against this industry due to effluents released by the paper mills into open drains, rivulets and rivers thereby polluting the environment. Unless technology to solve the effluent problem is evolved and implemented with only marginal additional investment, many of the paper mills run the risk of economic losses and even closure.

India is facing wide gap between supply and demand of paper even at the low rate of consumption. Currently, India has about 17.5 per cent of the world's population but consumes a little over 1 per cent of the world's paper and paper board. With the spread of education and literacy, demand for paper is bound to increase and is expected to be double the present demand within ten years. This will constraint India either to increase the indigenous production considerably or resort to large scale imports.

The average size of paper mills is abnormally low at less than 10,000 tonnes against 50,000 tonnes in South-east Asia and 85,000 tonnes in Asia Pacific. The small size of the manufacturing units makes them uneconomic, prohibits the induction of new technology, needs larger capital inputs in proportion to the final production and increases the cost of operations. Several mini plants are using old technologies and worn out machinery and badly lack competitive strength. The spiralling cost of imported wood pulp and waste paper coupled with unremunerative selling price of the finished paper has rendered many paper mills economically unviable and forced them to close down. Recently, the Department of Industrial Policy and Promotion had commissioned a study on 'Global Competitiveness' of Indian Paper Industry by an agency of international repute to understand various issues concerning the paper and newsprint industry. The study had indicated inadequate availability of good quality of cellulosic raw material and obsolete technology, among others as the constraints for the paper industry. High cost of basic inputs and environmental issues are the other two major problems required to be addressed by the paper industry to become globally competitive.

However, one encouraging aspect is that Indian paper industry has trained manpower whose skill can be gainfully used to adopt modern technology for manufacturing paper and paper board of international standard at relatively lower manpower cost inputs. The country has vast reservoir of unemployed rural labour which can be deployed for development of raw materials. Thus, we can overcome some of the weaknesses which have plagued the paper industry for a long time.

MATCH INDUSTRY

The first match factory was set up at Ahmedabad in 1921. The Western India Match Company (WIMCO) came into existence in 1923 and it set up five factories at Bareilly (U.P.), Kolkata, Chennai, Ambarnath (Mumbai) and Dhubri (Assam). These five factories of WIMCO along with Assam Match Co. (AMCO.) produce about 65 per cent matches in India. The remaining 35 per cent match is produced by de-centralised small scale units and cottage industry. There are about one thousand small scale units manufacturing match. The production has shown varying trends.

Localisation

The chief raw materials used in this industry are soft timber and paper for making sticks and boxes. The main chemicals used are phosphorus, potassium chlorate, paraffin, potash, etc. Earlier, most of the timber requirements were met by imports. Now, locally available wood like *genwa*, *pipita*, *dhup*, *didu*, *bakoda*, *mango*, *semal* and *solai* is used and imports are drastically reduced. But most of the chemicals are still imported. Match factory requires cheap and skilled labour because one-third of the cost of manufacturing match is on labour.

Distribution

West Bengal, Tamil Nadu, Maharashtra and Gujarat are the main producers.

West Bengal has the highest concentration of match industry. Timber is obtained from Andaman and Nicobar Islands as well as from the Sunderbans. Some timber is imported from Sweden. Kolkata serves as a good port for importing chemicals. Coal is obtained from Jharia and Raniganj. The area is densely populated and there is no dearth of labour. 24 Parganas and Kolkata have the greatest concentration of match industry in this state. ***Tamil Nadu*** has nearly two-thirds of non-mechanised small scale units. The main centres are Ramnathpuram, Chingleput, Tirunelveli and Chennai. The other producers are ***Maharashtra*** (Pune, Thane, Chandrapur, Mumbai), ***Gujarat*** (Ahmedabad, Petlad, Ambarnath), ***Uttar Pradesh*** (Bareilly, Meerut, Allahabad, Varanasi), ***Karnataka*** (Shimoga), ***Kerala*** (Thiruvananthapuram), ***Telangana*** (Hyderabad, Warangal), ***Assam*** (Dhubri), ***Rajasthan*** (Kota), ***Madhya Pradesh*** (Bilaspur and Jabalpur).

LAC INDUSTRY

Lac is obtained from an insect named Cerria lacca which secretes a resin. This insect lives on trees which grow in areas at an elevation of 300 metres above sea level and having 12°C temp. and 150 cm annual rainfall. Resin is known as sticklac in its crude form and shellac or lac in the refined form. Lac is used for a variety of purposes including gramophone records, french polish, electrical insulating materials, shellac moulded articles, micanite, hats, grinding wheels, adhesives, cements, wood turning, metal enamelling, printing ink, paints and varnishes, photographic equipment, bangles, toys and many more.

The average annual production of lac in India is 20-25 thousand tonnes. Earlier, India was the largest producer of lac in the world and used to produce about 85 per cent of the world's total production of lac. But India's share in the world production of lac has fallen to 50-60 per cent due to increased production in Thailand, Myanmar and Indochina. Major part of the production comes from the Chota Nagpur plateau which accounts for about 50 per cent of the total production. The remaining 50 per cent is produced by adjoining areas in West Bengal, Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Odisha, Maharashtra. ***Madhya Pradesh*** produces 25 per cent of India's lac. The main producing districts are Balaghat, Chhindwara, Jabalpur, Shahdol. About 15 per cent lac of India comes from ***Chhattisgarh*** where Bilaspur, Raipur, Surguja and Karia are the main producing districts.. In ***West Bengal***, Murshidabad, Malda and Bankura are the main lac producing districts. The other producers are ***Odisha*** (Mayurbhanj, Bolangir, Dhenkanal, Sambalpur and Keonjhar), ***Meghalaya*** (Garo, Khasi and Jaintia Hills), ***Assam*** (Nagaon, Kamrup and Sibsagar districts), ***Uttar Pradesh*** (Mirzapur), ***Gujarat*** (Panchmahals and Vadodara) and ***Maharashtra*** (Bhandara).

International Trade

India has been a traditional exporter of lac and is still the largest exporter in the world. About 85-90 per cent of the total product finds its way to foreign markets. The USA, UK, Germany and Russia are the main buyers and account for over 50 per cent of the country's total lac exports. The other buyers include Italy, France, Japan, Sweden, Australia, Brazil, Argentina, etc. India also imports raw lac from Thailand and re-exports it in the form of finished products.

SPORTS GOODS

Sports goods industry was first established at Sialkot (now in Pakistan) and Meerut in Uttar Pradesh. From a modest beginning the industry made rapid progress after Independence when several skilled workers shifted from Sialkot to various towns and cities of India including Meerut, Jalandhar, Delhi, Batala, Kolkata, etc. Later on this industry spread to Jammu, Srinagar, Patiala, Faridabad, Modinagar, Dehradun, Bulandshahr, Lucknow, Allahabad, Amritsar, Bhopal, Katni, Chennai, Mumbai, Pune and many more cities. Meerut and Jalandhar dominate the production of sports goods. Meerut has 270 units out of a total of 700 units in the whole of the country. Jalandhar has made rapid progress during the last couple of decades and manufactures quality sports goods.

Today, India is in a position to manufacture goods for almost all the sports. The factors contributing to India's progress in sports goods are the availability of raw materials and skilled, cheap and abundant labour. The principal raw materials used in this industry are wood, leather, rubber, metal, etc.

Indian sports goods are of good quality and are in great demand throughout the world. U.K., Germany, Australia, Malaysia and Singapore are the main buyers of Indian sports goods.

FOOD AND ALLIED INDUSTRIES

This group includes those industries which are connected with food. Sugar, edible oils and vanaspati, flour milling, rice milling, alcohol, etc. are some of the examples of food and allied industries.

SUGAR INDUSTRY

Sugar can be produced from sugarcane, sugar-beet or any other crop having sugar content. But in India, sugarcane is the main source of sugar. At present, this is the second largest agro-based industry of India after cotton textile industry. India is the world's second largest producer of sugarcane after Brazil and second largest producer of sugar after Cuba. But India becomes the largest producer if *gur* and *khandsari* are also included. This industry provides employment to 2.86 lakh workers. In addition, 2.50 crore sugarcane growers also get benefit from this industry.

Growth and Development

India has a long tradition of manufacturing sugar. References of sugar making by the Indians are found even in the *Atharva Veda*. India is rightly called the *homeland of sugar*. But in ancient times, only *gur* and *khandsari* were made and modern sugar industry came on the Indian scene only in the middle of the 19th century, when it was introduced by the Dutch in North Bihar in about 1840. Unfortunately, this attempt could not succeed. The first successful attempt was made by the indigo planters at the initiative of Britishers in 1903 when Vacuum pan mills were started at Pursa, Pratabpur, Barachakia and Marhowrah and Rose in north-eastern U.P. and the adjoining Bihar. This happened when demand for indigo ceased to exist due to the introduction of synthetic blue in the market. In the early years of the 20th century, the industry grew rather sluggishly and there were only 18 mills in 1920-21 and 29 mills in 1930-31. The industry got a great fillip after the fiscal protection in 1931 and the number of mills rose to 137 in 1936-37. The production also shot up from 1.58 lakh tonnes to 9.19 lakh tonnes during the same period. The industry passed through an uncertain phase during and after the World War II and some stability was experienced only after 1950-51. There were 139 mills producing 11.34 lakh tonnes of sugar in 1950-51. After that, the plan period started and the industry made rapid strides. In the year 1994-95, there were 420 mills producing 148 lakh tonnes of sugar.

Table 25.24 shows that the year to year figures reveal great variations in production although there has been a steady increase in production on the long term basis.

Localisation of Sugar Industry

Sugar industry in India is based on sugarcane which is a heavy, low value, weight losing and perishable raw material. Sugarcane cannot be stored for long as the loss of sucrose content is inevitable. Besides, it cannot be transported over long distances because any increase in transportation cost would raise the cost of production and the sugarcane may dry up on the way. It is estimated that 50 per cent cost of production is accounted for by sugarcane alone. Normally, it requires about 100 tonnes of sugarcane to produce 10-12 tonnes of sugar. Even today most of sugarcane is transported with the help of bullock carts and cannot be carried beyond 20-25 km. The introduction of tractor-trollies, trucks and even railway wagon have increased the distance covered by sugarcane to 70-75 kms. beyond which the transportation cost would increase exorbitantly. Therefore, the sugar industry is established in areas of sugarcane cultivation.

Distribution

Figure 25.15 makes it amply clear that sugar industry has two major areas of concentration. One comprises Uttar Pradesh, Bihar, Haryana and Punjab in the north and the other that of Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh in the south.

Maharashtra. Maharashtra has progressed a lot and captured first position from U.P. to emerge as the largest producer of sugar in India. Large production of sugarcane, higher rate of recovery and longer crushing period are some of the factors which have helped the state to occupy this enviable position. The state has one-fourth of the total sugar mills and produces a little more than one-third of the total sugar of India. Sugar mills of Maharashtra are much larger as compared to the mills in other parts of the country. The major concentration of sugar mills is found in the river valleys in the western part of the Maharashtra

TABLE 25.24. Production of Sugar in India (thousand tonnes)

Year*	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Production	1,134	3,029	3,740	5,148	12,047	18,510	19,321	28,199	26,300	14,677	18,802	24,350	27,430

*Relates to October-September

Sources : Economic Survey, 2012-13, p. A-33.

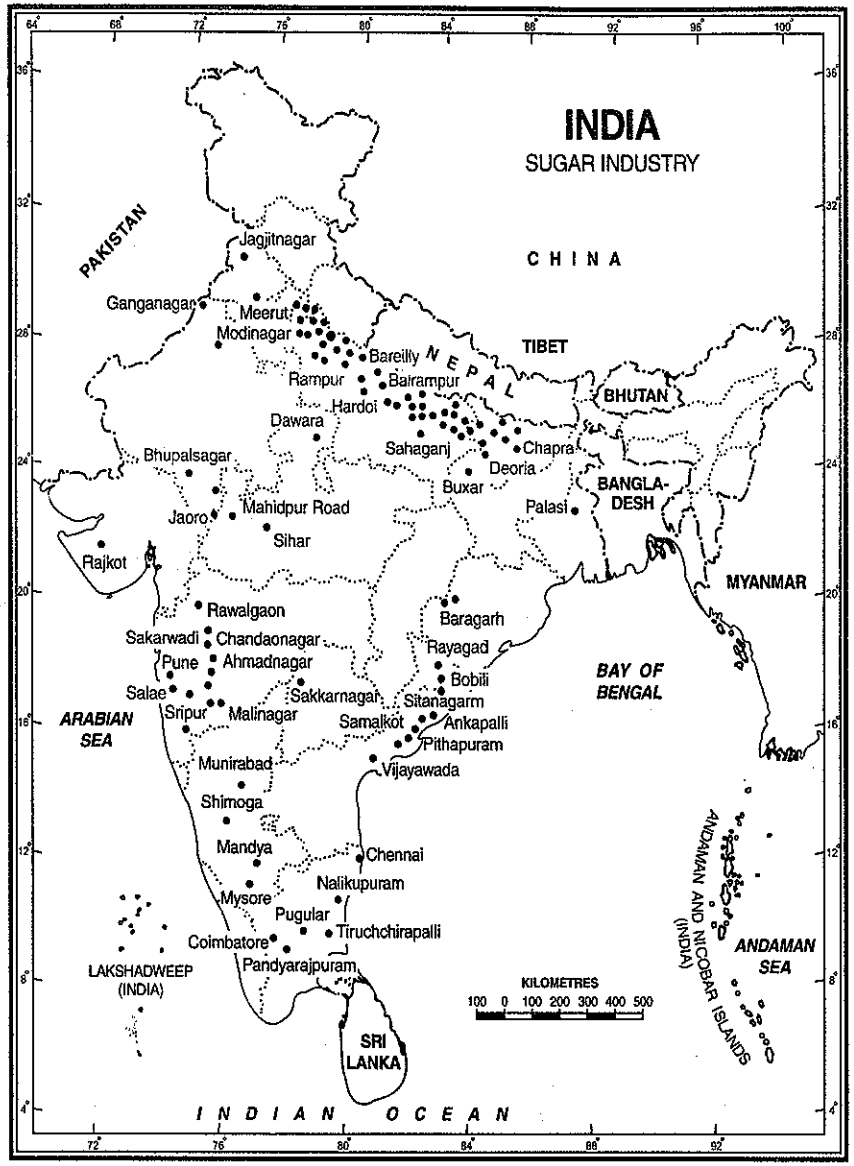


FIG. 25.15. India : Distribution of Sugar Industry

Plateau. Ahmednagar is the largest centre. The other major centres are in the districts of Kolhapur, Solapur, Satara, Pune and Nashik.

Uttar Pradesh. Uttar Pradesh is the traditional producer of sugar and has been occupying the first rank among the major sugar producing states of India. However, its relative importance has been reduced during the last few years and the state has conceded the top position to Maharashtra and now occupies the second position. Uttar Pradesh has more mills than Maharashtra but they are of comapratively smaller size and yield less production. Presently, the state accounts for about 24 per cent of the total production of sugar in India. There are two distinct regions of sugar production in this state. One region consists of Gorakhpur, Deoria, Basti and Gonda in eastern Uttar Pradesh and the other lies in the upper Ganga Plain consisting of Meerut, Saharanpur, Muzaffarnagar, Bijnore and Moradabad.

Tamil Nadu. Tamil Nadu has shown phenomenal progress with regard to sugar production during the last few years. High yield per hectare of sugarcane, higher sucrose content, high recovery rate and long crushing season have enabled Tamil Nadu to obtain highest yield of 9.53 tonnes of sugar per hectare in the whole of India. As a result of these advantages, the state has emerged as the third largest producer of sugar, contributing over nine per cent of the total sugar production of India. Most of the 32 mills of the state are located in Coimbatore, Tiruppur, Karur and Tiruchchirapalli.

Karnataka. Karnataka has 30 mills producing over 6 per cent of the total sugar of India. Belgaum and Mandya districts have the highest concentration of sugar mills. Bijapur, Bellary, Shimoga and Chittradurga are the other districts where sugar mills are scattered.

Andhra Pradesh. Andhra Pradesh has more mills (35) than the neighbouring Karnataka but produces only 5.8 per cent of India's sugar. This means that the mills are comparatively smaller. Majority of the sugar mills are concentrated in East Godawari West Godavari, Krishna, Vishakhapatnam, and Chittoor districts.

Gujarat. Gujarat's 16 mills are scattered in Surat, Bhavnagar, Amreli, Banaskantha, Junagarh, Rajkot and Jamnagar districts. The state produces about 5.56 per cent of the total sugar produced in India.

Telangana. Most of the sugar mills are concentrated in Nizamabad and Medak districts.

Haryana. Haryana has only 8 mills but their large size enables the state to contribute 1.91 per cent of the total sugar production. Sugar mills are located in Rohtak, Ambala, Panipat, Sonipat, Karnal, Palwal and Hisar districts.

Punjab. Punjab has a total of 13 mills which are located in Amritsar, Jalandhar, Gurdaspur, Sangrur, Patiala and Rupnagar districts.

Bihar. Bihar was the second largest sugar producing state next only to Uttar Pradesh till mid-1960s. Since then the state has been experiencing sluggish growth and consequently lost its prestigious position to the peninsular states like Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh. Its 28 mills make an insignificant contribution to the production of sugar. The belt of eastern Uttar Pradesh extends further east in Bihar and the districts of Darbhanga, Saran, Champaran and Muzaffarpur are included in this belt.

Others. Among the other producers are Madhya Pradesh (8 mills in Morena, Gwalior and Shivpuri districts), Rajasthan (5 mills in Ganganagar, Udaipur, Chittaurgarh and Bundi districts), Kerala, Odisha, West Bengal and Assam.

Difference between the Sugar Industry of Northern and Peninsular India

There are marked differences between the sugar industry of the northern and the peninsular India. As a result of better conditions prevailing in the peninsular India, the sugar industry is gradually shifting from north India to the peninsular India. This is evident from the fact that previously north India used to produce about 90 per cent of India's sugar which is reduced to 35-40 per cent now. A brief description of differences between the sugar industry of the northern and peninsular India is given below :

1. Peninsular India has tropical climate which gives higher yield per unit area as compared to north India.
2. The sucrose content is also higher in tropical variety of sugarcane in the south.
3. The crushing season is also much longer in the south than in the north. For example, crushing season is of nearly four months only in the north from November to February, whereas it is of nearly 7-8 months in the south where it starts in October and continues till May and June.
4. The co-operative sugar mills are better managed in the south than in the north.
5. Most of the mills in the south are new which are equipped with modern machinery.

Problems of Sugar Industry

Sugar industry in India is plagued with several serious and complicated problems which call for immediate attention and rational solutions. Some of the burning problems are briefly described as under :

1. Low Yield of Sugarcane. Although India has the largest area under sugarcane cultivation, the yield per hectare is extremely low as compared to some of the major sugarcane producing countries of the world. For example, India's yield is only 68,344 kg/hectare as compared to 72,910 kg/hectare in Mauritius, 74,231 kg/hectare in Thailand, 114983 kg/hectare in Egypt, 1,25,164 kg/hectare in Colombia and 1,27,812 kg/hectare in Peru. The world average is 68,854 kg/hectare (data for 2012). This leads to low overall production and results in short supply of sugarcane to sugar mills. Efforts are being made to solve this problem through the introduction of high yielding, early maturing, frost resistant and high sucrose content varieties of sugarcane as well as by controlling diseases and pests which are harmful for sugarcane.

2. Short crushing season. Manufacturing of sugar is a seasonal phenomena with a short crushing season varying normally from 4 to 7 months in a year. The mills and its workers remain idle during the remaining period of the year, thus creating financial problems for the industry as a whole. One possible method to increase the crushing season is to sow and harvest sugarcane at proper intervals in different areas adjoining the sugar mill. This will increase the duration of supply of sugarcane to sugar mills.

3. Fluctuating Production Trends. Sugarcane has to compete with several other food and cash crops like cotton, oil seeds, rice, etc. Consequently, the land available to sugarcane cultivation is not the same and the total production of sugarcane fluctuates. This affects the supply of sugarcane to the mills and the production of sugar also varies from year to year.

4. Low rate of recovery. The average rate of recovery in India is less than ten per cent which is quite low as compared to other major sugar producing countries. For example recovery rate is as high as 14-16 per cent in Java, Hawaii and Australia.

5. High cost of Production. High cost of sugarcane, inefficient technology, uneconomic process of production and heavy excise duty result in high cost of manufacturing. The production cost of sugar in India is one of the highest in the world. Intense research is required to increase the sugarcane production in the agricultural field and to introduce new technology of production efficiency in the sugar mills. Production cost can also be reduced through proper utilisation of by-products of the industry. For example, bagasse can be used for manufacturing paper pulp, insulating board, plastic, carbon, coltex, etc. Molasses comprise another important by-product which can be gainfully used for the manufacture of power alcohol. This, in its turn, is useful in manufacturing DDT, acetate rayon, polythene, synthetic rubber, plastics, toilet preparations, etc. It can also be utilised for conversion into edible molasses and cattle feed. Press-mud can be used for extracting wax.

6. Small and uneconomic size of mills. Most of the sugar mills in India are of small size with a capacity of 1,000 to 1,500 tonnes per day. This makes large scale production uneconomic. Many of the mills are economically not viable.

7. Old and obsolete machinery. Most of the machinery used in Indian sugar mills, particularly those of Uttar Pradesh and Bihar is old and obsolete, being 50-60 years old and needs rehabilitation. But low margin of profit prevents several mill owners from replacing the old machinery by the new one.

8. Competition with Khandsari and Gur. Khandsari and gur have been manufactured in rural India much before the advent of sugar industry in the organised sector. Since *khandsari* industry is free from excise duty, it can offer higher prices of cane to the cane growers. Further, cane growers themselves use cane for manufacturing *gur* and save on labour cost which is not possible in sugar industry. It is estimated that about 60 per cent of the cane grown in India is used for making *khandsari* and *gur* and the organised sugar industry is deprived of sufficient supply of this basic raw material.

9. Regional imbalances in distribution. Over half of sugar mills are located in Maharashtra and Uttar Pradesh and about 60 per cent of the production comes from these two states. On the other hand, there are several states in the north-east, Jammu and Kashmir and Odisha where there is no appreciable growth of this industry. This leads to regional imbalances which have their own implications.

10. Low per capita consumption. The per capita annual consumption of sugar in India is only 16.3 kg as against 48.8 kg in the USA., 53.6 kg in U.K., 57.1 kg in Australia and 78.2 kg in Cuba and the world average of about 21.1 kg. This results in low market demand and creates problems of sale of sugar.

TABLE 25.25. Production of Vanaspati

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Production ('000 tonnes)	155	355	558	753	850	1,445	1,193	1,285	1,380	1,532	1,112	1,827	1,235

Source : Economic Survey 2012-13, p. A-33.

VEGETABLE OIL INDUSTRY

Vegetable oil is an important item of Indian food as it is the major source of fat. Vegetable oil industry of India can be divided into three broad groups depending upon the technology used.

(*i*) ***Ghani*** is the main technology for expelling oil in the villages. Different oil seeds are used in different areas. For example, groundnut is used in Gujarat, coconut in Kerala and mustard seed in Uttar Pradesh.

(*ii*) Factories using intermediate level of technology are located in towns. Oil seeds used are region specific.

(*iii*) Large scale sophisticated mills are located in big cities and are oriented towards bigger market. They also procure oil seeds from a much larger area.

Vanaspati is 'hydrogenated' oil. The first vanaspati factory was established in 1930 which produced a meagre of 298 tonnes. The World War II and the levy of import duty on vanaspati gave a fillip to this industry and in 1951, there were 48 factories with a capacity of 3.3 lakh tonnes and a production of 155 thousand tonnes. The production showed a significant progress and stood at 1,445 thousand tonnes in 2000-11 after which varying trends in production have been observed.

Although vegetable oil industry has developed throughout India, Maharashtra has the largest number of vanaspati producing units. Other important vanaspati producing states are Uttar Pradesh, Gujarat, Punjab, Andhra Pradesh, West Bengal, Karnataka, Rajasthan, Tamil Nadu and Madhya Pradesh. Chennai, Akola, Modinagar, Kanpur, Ghaziabad, Indore and Vadodara are the main centres of vegetable oil industry.

Production of vegetable oils falls short of the domestic demand and the country has to import oil seeds as well as vegetable oils from other countries.

Table 25.26 shows that imports of edible oils and their value in terms of foreign exchange spent in these imports keeps on changing depending upon the availability of edible oils in the country. However, there had been steep rise in the imports of edible oils since 1995-96. In 2013-14, India had to spend a huge amount of ₹ 56,489 crore to import 10,434.2 thousand tonnes of edible oils.

TABLE 25.26. Import of Edible oils

Year	1960-61	1970-71	1980-81	1990-91	1995-96	2000-01	2010-11	2011-12	2012-13	2013-14
Quantity (Thousand tonnes)	31.1	84.7	1,663.3	525.8	1,062.0	4,267.9	6,677.6	8,445.0	11013.7	10434.2
Value (₹ crore)	4	23	677	326	2,260	6,093	29,860	46,255	61107	56489

Source : Economic Survey, 2013-14, Statistical Appendix, pp. 71-73.

Cottage Industries

Industries which the artisans set-up in their houses and produce finished goods with the help of their family member by using locally available raw materials are known as cottage industries. In other words, cottage industry is a type of industry where creation of products and services is home based, rather than factory based. While the products and

services created by cottage industry are often unique and distinctive given the fact that they are usually not mass-produced, producers in this sector often face numerous disadvantages when trying to compete with much larger factory based companies.

The artisan may sell the product directly to the consumes or to an entrepreneur who pays money to the artisan according to the quality and quantity of the finished product. This type of industry has a long history in India and was perhaps the first industry developed in the country at the village level. It involves minimum investment and modern technical input and can be found in all parts of the country. It provides employment to a large number of people, many of them are unskilled or semi-skilled and belong to SC/ST and other backward classes including women. *Bidi* making, sports goods, lac industry, basket making, extracting oil from oilseeds, manufacture of crackers, toys, embroidery, handloom, khadi, utensil making, idol making, leather work etc. fall in the category of cottage industries. The main raw materials used by the artisans are wood, cane, leaves, leather, brass, stones of different varieties, etc. Some of the important industries have already been discussed in this chapter and some others are briefly described below.

Bidi Making. Bidi is made from *tandu* leaves or *Kachnal*. These two basic raw materials for bidi making are found in the forests of Chhattisgarh, Madhya Pradesh and West Bengal as well as on the slopes of the Eastern Ghats. An important ingredient of *bidi* making is inferior quality tobacco which is available in Andhra Pradesh, Telangana, Bihar, Chhattisgarh, Madhya Pradesh and Uttar Pradesh. The annual production of *bidi* is more than ten billion numbers. The main areas of *bidi* production are Bastar and Jagatpur in Chhattisgarh, Belgaun and Mangalore in Karnataka, Bhandura, Nagpur, Gondia, Kamptee, Pune and Nasik in Maharashtra, Jabalpur, Bhind and Murena in Madhya Pradesh, Kheda and Vadodra in Gujarat and Hyderabad in Telangana. As against cigarette, *bidi* is considered to be a cheap and light smoke and is relished by a large number of people belonging to lower strata of society in India. India is a net exporter of bidi to a large number of countries in Asia, Africa and Europe.

Basket Making. This is a typical cottage industry of hilly and mountain areas where baskets are prepared by using locally available raw materials from the forests. Bamboo, cane and willow are the chief raw materials used for basket making. The main areas of basket making are in the states of Sikkim, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya, Tripura, Jammu and Kashmir, Maharashtra, Madhya Pradesh, Uttar Pradesh, Odisha and West Bengal.

Others. Mirzapur district of Uttar Pradesh is famous for making *carpets* while Kashmir valley is well known for exclusive embroidery on shawls and other woolen garments. Lucknow's needle work on *kurtas* and other wearings is well known are over India. In Tamil Nadu, *Cracker* making is an important cottage industry. Almost each and every village in India has a cobbler who make shoes for the villagers and for sale in the adjoining markets. Similarly there are persons who make utensils, particularly from brass.

INDUSTRIAL REGIONS

Industries are unevenly distributed in India because the factors affecting industrial location are not the same everywhere. Industries tend to concentrate in a few pockets because of certain favourable factors. The pockets having high concentration of industries are known as *industrial regions*.

Goegraphers and specialists in other allied fields have made several attempts to delineat industrial regions of India making use of different criteria. One of the first attempts was made by Trewartha and Burnet in 1944 using employment figures. Karan and Jenkins tried to demarcate industrial regions of India on empirical basis. These attempts have become outdated and have lost much of their relevance because industrial landscape in India has undergone drastic changes during the planning era. **J.E. Spencer** and **W.L. Thomas** have also discussed this subject in their book entitled *Asia, East by South*. **R.L. Singh** recognised ten regions based on empirical observation. They are (*i*) Hugli, (*ii*) Mumbai, (*iii*) Ahmedabad (*iv*) The north-western extending from Ghaziabad to Amritsar (*v*) Lucknow-Kanpur (*vi*) Bangalore-Madras (*vii*) Quilon-Coimbatore (*viii*) Madurai (*ix*) Dalmiapuram and (*x*) Digboi-Dibrugarh.

The Centre for Monitoring Indian Economy (CMIE) recognised the industrial centres on the basis of industrial employment exceeding 10,000 in 1971.

Dr. B.N. Sinha (1972) has classified industrial regions into following three categories :

(*i*) **Major Industrial Region** is identified on the basis of a minimum daily factory working force of 1.5 lakh

(*ii*) **Minor Industrial Region** must have a minimum of 25,000 working labour force.

(*iii*) **Manufacturing District** has a working labour force of less than 25,000.

Another basis of indentification of industrial regions is the number of manufacturing units located close to one another or the quantum of industrial environment. Major industrial regions of India have developed in the immediate hinterlands of the ports of Kolkata, Mumbai and Chennai. The Britishers developed these clusters because the hinterlands of these ports provided enough raw materials, power and market. With the development of good transportation, some power resources like coal could also be brought easily.

Major Industrial Regions

Following are the major industrial regions of India (**Fig. 25.16**) :

1. Mumbai-Pune Industrial Region.
2. Hugli Industrial Region.
3. Bangalore-Tamil Nadu Industrial Region.
4. Gujarat Industrial Region.
5. Chotanagpur Industrial Region.
6. Vishakhapatnam-Guntur Industrial Region.
7. Gurgaon-Delhi-Meerut Industrial Region.
8. Kollam-Thiruvananthapuram Industrial Region.

1. Mumbai-Pune Industrial Region. This region extends from Thane to Pune and in adjoining districts of Nashik and Solapur. In addition, industries have grown at a rapid pace in Kolaba, Ahmednagar, Satara, Sangli and Jalgaon districts also. This region owes its origin to the British rule in India. The seeds of its growth were sown in 1774 when the island-site was obtained for construction of Mumbai port. The opening of the first railway track of 34 kms between Mumbai and Thane in 1853, opening of the Bhor and Thal Ghats respectively to Pune and Nashik and that of Suez canal in 1869 led to the development of Mumbai.

The growth of this industrial region is fully connected with the growth of cotton textile industry in India. As the coal was far removed, hydel power was developed in Western Ghats. Cotton was cultivated in the black cotton soil area of the Narmada and Tapi basins. Cheap labour-force came from the hinterland, the port facilities for export-import and communication links with the peninsular hinterland made Mumbai the *'Cottonopolis of India'*. With the development of cotton textile industry, the chemical industry developed too. Opening of the Mumbai High petroleum field and erection of nuclear energy plants added additional magnetic force to this region. Now the industrial centres have developed, from Mumbai to Kurla, Kolaba, Thane, Ghatkopar, Ville Parle, Jogeshwari, Andheri, Thane, Bhandup, Kalyan, Pimpri, Pune, Nashik, Manmad, Solapur, Ahmednagar, Satara and Sangli. In addition to cotton textile and chemical industries, engineering goods, leather, oil refineries; petrochemicals, synthetic and plastic goods, chemicals, drugs, fertilizers, electricals, electronics, software, ship-building, transport and food industries have also developed here.

The partition of the country in 1947 adversely affected this region because 81% of the total irrigated cotton area growing long staple cotton went to Pakistan. Mumbai, the nucleus of this industrial region, is facing the current limitation of space for the expansion of the industry. Dispersal of industries is essential to bring about decongestion.

2. The Hugli Industrial Region. Located in West Bengal, this region extends as a narrow belt running along the river Hugli for a distance of about 100 km from Bansbaria and Naihati in the north to Birlanagar in the south. Industries have also developed in Midnapur district in the west. The river Hugli offered the best site for the development of an inland river port as nucleus for the development of *Hugli industrial region*. The old trading centre of late 17th century has developed into the present industrial hub of Kolkata. Thus Kolkata-Haora form the nucleus of this region. It is very well-connected by the Ganga and its tributaries with the rich hinterland of Ganga-Brahmaputra plains. Besides navigable rivers, roads

and the railways provided subsequent links to the great benefit of Kolkata port.

The discovery of coal and iron ore in Chotanagpur plateau, tea plantations in Assam and northern parts of West Bengal and the processing of deltaic Bengal's jute led to the industrial development in this region. Cheap labour could be found easily from the thickly populated states of Odisha, Bihar, Jharkhand and eastern part of U.P. Kolkata, having been designated capital city of the British India (1773-1912) attracted large scale British investment of capital. Establishment of first jute mill at Rishra in 1855 ushered in the era of modern industrial clustering in this region. A chain of jute mills and other factories could be established on either side of Hugli river with the help of Damodar valley coal. The port site was best-suited for export of raw materials to England and import of finished goods from that country. Kolkata's industries have established by drawing in the raw materials from adjoining regions and distributing the finished goods to consuming points. Thus, the role of transport and communication network has been as important as the favourable locational factors in the growth of this region. By 1921, Kolkata-Hugli region was responsible for two-thirds of factory employment in India.

Just after the partition of old Bengal province in 1947, the region faced, for some years, the problem of shortage of jute as most of the jute-growing areas went to East Pakistan (now Bangladesh). The problem was solved by gradually increasing home production of jute. Cotton textile industry also grew along with jute industry. Paper, engineering, textile machinery, electrical, chemical, pharmaceuticals, fertilizers and petrochemical industries have also developed in this region. Factory of the Hindustan Motors Limited at Konanagar and diesel engine factory at Chittaranjan are landmarks of this region. Location of petroleum refinery at Haldia has facilitated the development of a variety of industries. The major centres of this industrial region are Kolkata, Haora, Haldia, Serampur, Rishra, Shibpur, Naihati, Kakinara, Shamnagar, Titagarh, Sodepur, Budge Budge, Birlanagar, Bansbaria, Belgurriah, Triveni, Hugli, Belur, etc.

Alarming rate of silting of the Hugli river was a very serious problem. The depth of water in the channel from bay head to Kolkata docks must be kept at 9.2 metres for big ocean ships to come in. Dredging out of the silt rapidly filling up the water channel was very costly and not a permanent solution to save the life of Kolkata port. The construction of Farakka barrage about 300 kms upstream on Ganga and flushing of the channel are the only possible answers. The construction of Haldia port in the lower reaches of Hugli to the south of Kolkata is another landmark in relieving the great pressure of cargo ships on the port of Kolkata. However, the industrial growth of this region has slowed down as compared to the other regions. There are several reasons for this sluggish growth but decline in jute industry is said to be one of the main reasons.

3. Bangalore-Tamil Nadu Industrial Region. Spread in two states of Karnataka and Tamil Nadu, this region experienced the fastest industrial growth in the post-independence era. Till 1960, industries were confined to Bangalore district of Karnataka and Salem and Madurai districts of Tamil Nadu. But now they have spread over all the districts of Tamil Nadu except Viluppuram.

This region is a cotton-growing tract and is dominated by the cotton-textile industry. In fact cotton textile industry was the first to take roots in this region. But it has large number of silk-manufacturing units, sugar mills, leather industry, chemicals, rail wagons, diesel engines, radio, light engineering goods, rubber goods, medicines, aluminium, cement, glass, paper, cigarette, match box and machine tools, etc. This region is away from the main coal-producing areas of the country but cheap hydro-electric power is available from Mettur, Sivasamudram, Papanasam, Pykara and Sharavati dams. Cheap skilled labour and proximity to vast local market as well as good climate have also favoured the concentration of industries in this region. Coimbatore has grown rapidly mainly owing to its industrial growth based on Pykara power, local cotton, coffee mills, tanneries, oil presses and cement works. Coimbatore is known as *Manchester of Tamilnadu* because of its large-scale cotton textile industry. The establishment of public sector units at Banglore like Hindustan Aeronautics, Hindustan Machine Tools, Indian Telephone Industry and Bharat Electronics etc. has further pushed up the growth of industries in the region. Madurai is known for its cotton textiles. Visvesvarayya Iron and Steel

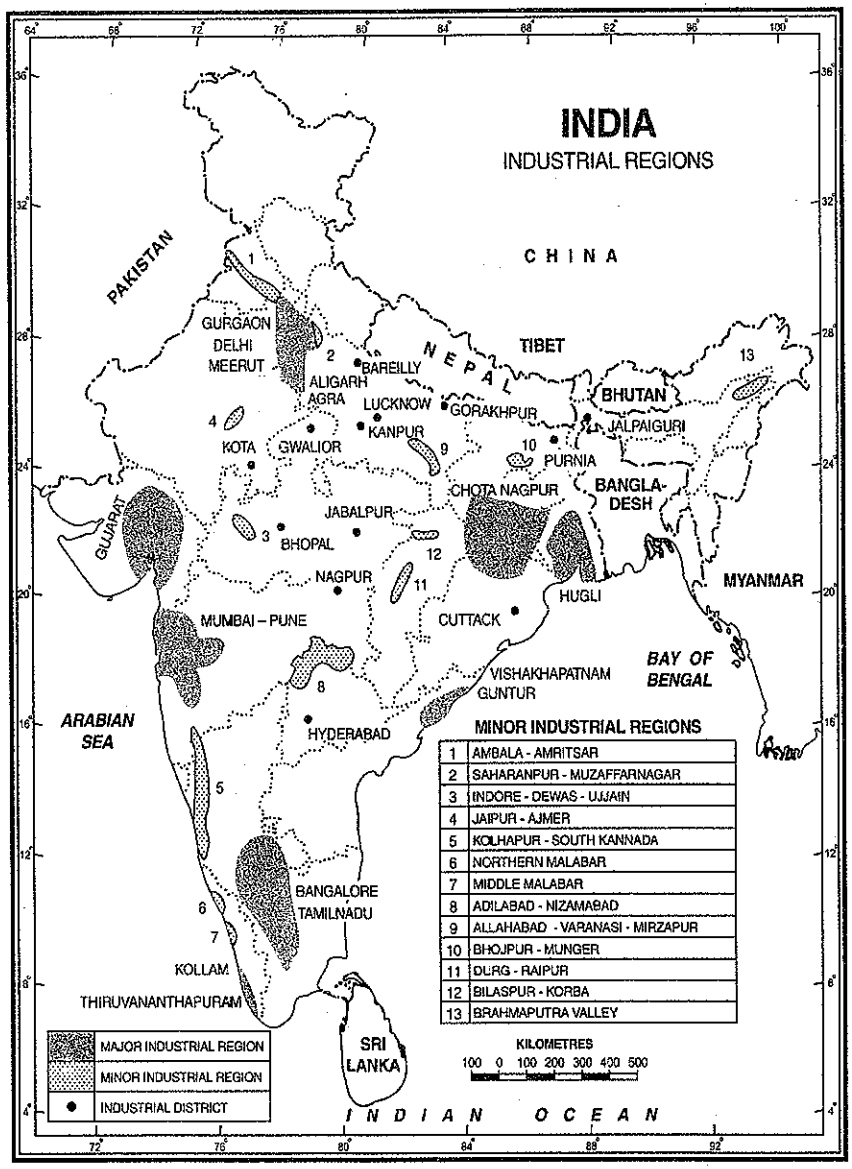


FIG. 25.16. India : Industrial Regions

Works is located at Bhadravati. The other important centres of this region are Sivakasi, Tiruchirapalli, Madukottai, Mettur, Mysore and Mandya. Petroleum refineries at Manali, Narimanam and Nagapattinam as well as iron and steal plant at Salem are recent developments.

4. Gujarat Industrial Region. The nucleus of this region lies between Ahmedabad and Vadodara as a result of which it is also known as **Ahmedabad-Vadodara** industrial region. However, this region extends upto Valsad and Surat in the south and Jamnagar in the west. The region corresponds to the

cotton growing tracts of the Gujarat plains and the development of this region is associated with the location of textile industry since 1860s. This region became important textile region with the decline of cotton textile industry in Mumbai. Mumbai has the disadvantage of paying double freight charges for first bringing the raw cotton from the peninsular hinterland and then despatching the finished products to inland consuming points in India. But Ahmedabad is nearer the sources of raw material as well as the marketing centres of the Ganga and Satlui plains. Availability of cheap land, cheap skilled labour and other advantages helped the cotton textile industry to develop. This major industrial region of the country, mainly consisting of cotton textile industry, is expanding at a much faster rate in providing a greater factory employment.

The discovery and production of oil at a number of places in the Gulf of Khambhat area led to the establishment of petrochemical industries around Ankleshwar, Vadodara and Jamnagar. Petroleum refineries at Koyali and Jamnagar provide necessary raw materials for the proper growth of petrochemical industries. The Kandla port, which was developed immediately after independence, provides the basic infrastructure for imports and exports and helps in rapid growth of industries in this region. The region can now boast of diversified industries. Besides textiles (cotton, silk and synthetic fibres) and petrochemical industries, other industries are heavy and basic chemicals, dyes, pesticides, engineering, diesel engines, textile machinery, pharmaceuticals, dairy products and food processing. The main industrial centres of this region are Ahmedabad, Vadodara, Bharuch, Koyali, Anand, Khera, Surendranagar, Surat, Jamnagar, Rajkot and Valsad. The region may become more important in the years to come.

5. Chotanagpur Industrial Region. As its name indicates, this region is located on the Chotanagpur plateau and extends over Jharkhand, Northern Odisha and Western part of West Bengal. The birth and growth of this region is linked with the discovery of coal in Damodar Valley and iron ore in the Jharkhand-Odisha mineral belt. As both are found in close proximity, the region is known as the *'Ruhr of India'*. Besides raw materials, power is available from the dam sites in the Damodar Valley and the thermal power stations based on the local coal. This region is surrounded by highly populated states of Jharkhand, Bihar, Odisha and West Bengal which provide cheap labour. The Kolkata region provides a large market for the goods produced in the Chotanagpur region. It also provides the port facility to the region. It has the advantages for developing ferrous metal industries. The Tata Iron and Steel Company at Jamshedpur, Indian Iron Steel Co., at Burnpur-Kulti, Hindustan Steel Limited at Durgapur, Rourkela and Bokaro are the important steel plants located in this region. Heavy engineering, machine tools, fertilizers, cement, paper, locomotives and heavy electricals are some of the other important industries in this region. Important nodal centres of this region are Ranchi, Dhanbad, Chaibasa, Sindri, Hazaribagh, Jamshedpur, Daltonganj, Garwa and Japla.

6. Vishakhapatnam-Guntur Industrial Region. This industrial region extends from Vishakhapatnam district in the north-eastern part of Andhra Pradesh to Kurnool and Prakasham districts in the south-east and covers most of the coastal Andhra Pradesh. The industrial development of this region mainly depends upon Vishakhapatnam and Machilipatnam ports. Developed agriculture and rich mineral resources in the hinterlands of these ports provide solid base to the industrial growth in this region. Coal fields of the Godavari basin are the main source of energy. Hindustan Shipyard Ltd. set up at Vishakhapatnam, in 1941 is the main focus. Petroleum refinery at Vishakhapatnam facilitated the growth of several petrochemical industries. Vishakhapatnam has the most modern iron and steel plant which has the distinction of being the only plant in India having coastal location. It uses high quality iron ore from Bailadila in Chhattisgarh. One lead-zinc smelter is functioning in Guntur district. The other industries of this region include sugar, textiles, paper, fertilizers, cement, aluminium and light engineering. The important industrial centres of this region are Vishakhapatnam, Vijaywada, Vijaynagar, Rajahmundry, Kurnool, Elum and Guntur. Recent discovery of natural gas in Krishna-Godavari basin is likely to provide much needed energy and help in accelerated growth of this industrial region.

7. Gurgaon-Delhi-Meerut Industrial Region. This region was developed after independence, but is one of the fastest growing regions of India. It consists

of two industrial belts adjoining Delhi. One belt extends over Agra-Mathura-Meerut and Saharanpur in U.P. and the other between Faridabad-Gurgaon-Ambala in Haryana. The region is located far away from the mineral and power resources, and therefore, the industries are light and market oriented. The region owes its development and growth to hydro-electricity from Bhakra-Nangal complex and thermal power from Harduaganj, Faridabad and Panipat. Sugar, agricultural implements, vanaspati, textile, glass, chemicals, engineering, paper, electronics and cycle are some of the important industries of this region. Software industry is a recent addition. Agra and its environs have glass industry. Mathura has an oil refinery with its petro-chemical complex. One oil refinery has been set up at Panipat also. This will go a long way to boost the industrial growth of this region. Gurgaon has Maruti car factory as well as one unit of the IDPL. Faridabad has a number of engineering and electronic industries. Ghaziabad is a large centre of agro-industries. Saharanpur and Yamunanagar have paper mills. Modinagar, Sonipat, Panipat and Ballabhgarh are other important industrial nodes of this region.

8. Kollam-Thiruvananthapuram Industrial Region. This is comparatively small industrial region and spreads over Thiruvananthapuram, Kollam, Alwaye, Ernakulam and Allapuzha districts of south Kerala. The region is located far away from the mineral belt of the country as a result of which the industrial scene here is dominated by agricultural products processing and market oriented light industries. Plantation agriculture and hydroelectricity provide the industrial base to this region. The main industries are textiles, sugar, rubber, match box, glass, chemical fertilizers, food and fish processing, paper, coconut coir products, aluminium and cement. Oil refinery set up in 1966 at Kochi provides solid base to petrochemical industries. Important industrial centres are Kollam, Thiruvananthapuram, Alluva, Kochi, Alappuzha and Punalur.

Besides the above mentioned eight major industrial regions, India has 13 minor industrial regions and 15 industrial districts. Their names are mentioned below :

Minor Industrial Regions

1. Ambala-Amritsar in Haryana-Punjab.
2. Saharanpur-Muzaffarnagar-Bijnaur in Uttar Pradesh.
3. Indore-Dewas-Ujjain in Madhya Pradesh.
4. Jaipur-Ajmer in Rajasthan.
5. Kolhapur-South Kannada in Maharashtra-Karnataka.
6. Northern Malabar in Kerala.
7. Middle Malabar in Kerala.
8. Adilabad-Nizamabad in Andhra Pradesh.
9. Allahabad-Varanasi-Mirzapur in Uttar Pradesh.
10. Bhojpur-Munger in Bihar.
11. Durg-Raipur in Chhattisgarh.
12. Bilaspur-Korba in Chhattisgarh.
13. Brahmaputra Valley in Assam.

Industrial Districts

1. Kanpur, 2 Hyderabad, 3. Agra, 4. Nagpur, 5 Gwalior, 6. Bhopal, 7. Lucknow, 8. Jalpaiguri, 9. Cuttack, 10. Gorakhpur, 11. Aligarh, 12. Kota, 13. Purnia, 14. Jabalpur, 15. Bareilly.

INDUSTRIAL HOUSES IN INDIA

India has experienced rapid industrial growth, particularly after the new Industrial Policy of 1991 and India has emerged as one of the few industrial giants of the world. This is due to a variety of factors, important of which are vast and solid natural resource base, increasing interest of the common man in industries and incentives from the government. Above all these factors is the major contribution made by some big industrial houses towards industrial growth. Although most of the industrial houses have emerged on the industrial scene in India after Independence, some of the industrial houses were functioning even before Independence. These industrial houses have laid solid foundation and given a new direction to industrial growth of India. They have made a commendable contribution to make India an industrial force to reckon with at the international level. In the year 1965, the Monopolies Inquiry Commission found that 75 industrial houses have absolute control over 1,536 companies. Industrial Licencing Policy Inquiry Committee accepted the concept of industrial houses and Dutt Committee identified 20 big industrial houses in 1963-64, each with an investment

of ₹ 35 crores. Larger scale changes were observed in the functioning of these industrial houses after Industrial Policy and Policy of Liberalization in 1991. A brief description of some of the major industrial houses is given as under :

1. The Tata. This is one of the oldest industrial houses active for the last over a century in India. The credit of laying solid foundation of India's industrial growth goes to this house as Jamshedji Tata established India's first large scale integral Iron and Steel manufacturing house at Sakchi in Singhbhum district of Jharkhand way back in 1907. Also known as Tatanagar, this place was later on renamed as Jamshadpur after Jamshadji. Since then, this house has never looked back and established a large number of industries. The main industries established by this house include automobiles, cement, publication, pharmaceuticals, power, energy, hospitality (hotels), refrigeration, air-conditioning, telecommunication, soft drinks, finance, insurance, consumer non-durables, etc. Tata Consultancy Services is an export oriented software development company which is one of the largest companies of India. It has left an indelible impact in the international market. It launched the low cost Nano car in the small car segment in 2009 which hit the headlines all over the world. However this car could not come upto high expectation of the buyers.

2. The Birla. Like the Tatas, the Birlas are also one of the oldest industrial houses in India. Their major contribution since inception has been in textile, paper, cement, aluminum, paraffin and automobile industries. In the recent past, the Birlas have diverted their attention towards diversification of industries and ventured into some other industries like telecommunications, pharmaceuticals, machine tools, consumer durables and non-durables, etc.

3. The Modi. Set-up by Gujarmal Modi, this is also one of the oldest industrials houses of India. The famous industrial town of Modinagar in Uttar Pradesh owes its origin and growth to this industrial house. The main industries set-up by this industrial house are textiles, ready-made garments, carpets, sugar, pharmaceuticals, tyres and tubes, hospitality, etc.

4. The Bajaj. This is also a very old industrial house of India which is known all over the world for its popular product, the Bajaj Scooter. They have started manufacturing motor-cycles also. The major industries of this house are electric and home appliances and entertainment. They are also venturing into small car segment.

5. The Ambanis. Dhiru Bhai Ambani spent his early life in acute poverty and deprivation but built a strong industrial empire by dint of his hard work and innovative ideas. His life story is the story of **rags-to-riches**. His vast industrial empire was divided between his two sons, namely Mukesh Ambani and Anil Ambani. The *Reliance Company* of Mukesh Ambani is credited with the discovery and production of natural gas in the Krishna-Godavari basin. It is a great achievement because it has solved India's energy problem to a great extent and charted the path to India's industrial progress. The traditional industries of this house are paraffin and synthetic yarn. Today this house runs more than a dozen industries which includes power, oil refining, textiles, garments, software, hospitality, telecommunication, pharmaceuticals, banking, insurance, etc. The oil refinery at Jamnagar in Gujarat with a capacity of 33 million metric tonnes per annum is the largest in India and perhaps the largest in the world.

6. The Sighania. This is also one of the oldest industrial houses of India. The main industries run by this house are textiles, pharmaceuticals, machine tools, tyres and tubes and entertainment.

7. The Sriram. Being credited as one of the oldest industrial houses of India, this house has a wide variety of industries which include textiles, ready-made garments, fertilizers, electricity, home appliances, generator sets, pharmaceuticals, hospitality, etc.

8. The Goenka. This is also one of the oldest industrial houses of the country. The main industries of this house are power generation and distribution, mechanic tools, pharmaceuticals, textiles, entertainment, etc.

9. The Escorts. This house also enjoys the privilege of being one of the oldest industrial houses in India. Its most important traditional industry has been tractor manufacturing. This was followed by manufacturing of motor-cycles. Of late, this house has made its mark in medical treatment. The heart-treatment hospitals run by this house provide world class heart-treatment at reasonably low cost.

10. The Oberois. This industrial house is well known for its mark in the hospitality industry. It has built high class hotels in different parts of India and in different countries in he world.

11. The Godrej. This is one of the top, oldest and famous industrial house which has been popular for manufacturing high class locks, furniture including almirahs, detergents, refrigerators, air-conditioners, etc. The Godrej produces are of high quality and meet international standards.

12. The Kirloskars. This is also one of the oldest and reputed industrial house of India and is famous for manufacturing high class heavy and light machine tolls. It has a place of pride in locomotion. The credit of producing India's first 'diesel pump set' goes to this industrial house. It has brought about a revolution in farm mechanization by manufacturing India's first tractor. Currently the company is producing a variety of farm implements. Its compressors are known for high quality performance. It is also producing cars in collaboration with Toyota.

13. The Jagjit Group. This industrial house is famous for textiles and sugar industries apart from distilleries.

14. The Sarabhais. The Sarabhais are mainly concerned with drugs and pharmaceutical industries for which they are renowned all over the world.

15. The Firodias. Being one of the oldest industrial houses the Firodias have attained specialization in the field of manufacturing automobiles (four wheelers and two wheelers) generator sets, etc.

16. The UB Group. This is considered to be one of the oldest industrial houses in India with manufacturing of alcoholic drink as its traditional industry. During the last few years, this industrial house has entered in fields of civil aviation, hospitality and structurals. Of late it has shown its presence in the real estate also.

17. The Thapars. This house is famous for paper, sugar and some allied industries. It has also made a significant contribution in the field of education.

18. The Infosys. The main industries of this house are electronics and software for which it is a well reputed house. Besides this house is making a significant contribution in the fields of education and social work.

19. The Wipro. The doyen of the sunrise industries, this industrial house of India is primarily involved in the field of software development and export including the production of computer peripherals. The company has earned world-wide acclaim in the development of software. This is also a leading company in the field of business process outsourcing (BPO). Like Infosys, this house is also seriously committed to social work.

20. The Bharti. The Bharti is famous for its 'Airtel' mobile phone for which it has sought collaboration with 'Airtel' company of America. Recently, this company has taken several steps to diversify its activities in the areas of software, internet, agriculture, hospitality and a host of others.

21. The Becon. Its main field of activity is Biotechnology. Although a comparatively new comer in the industrial field, it has carved a niche for itself.

22. The Ranbaxy. Its main specialization is the manufacturing of drugs and pharmaceuticals in which it has earned great reputation all over the world. In addition to catering to the needs of the domestic market, it exports its products to a number of countries. Many other companies have been inspired by the Ranbaxy.

23. Hamdard. This industrial house is has done a pioneer work in the Unani tradition of medicines in India and has the high tradition of preserving, pursuing and propagating this stream of medicines. Its *Rooh Afza sharbat* is very useful to patients as well as to healthy people. This is very popular in a large number of countries and has a vast domestic and international market. Its child tonic called *Shinkara* is also very popular with the consumers.

24. The Dabur. Its primary activity is the manufacturing of Ayurvedic medicines for which it has earned a name for itself. Many of the medicines produced by the Dabur are used by allopathic doctors, some of which are useful even for the cancer patients. During the recent years, this industrial house has taken steps to diversify its products and is venturing in the areas of consumer non-durable like fruit-based drinks and toiletries.

25. The Baidhyanath. Like the Dabur, this house is also known to preserve and propagate the Ayurvedic medicines and is quite renowned in this field.

26. The Arya Vaidyashala. This is known as harbinger of the Ayurvedic tradition in India and also runs a hospital dealing with Ayurvedic treatment and naturopathy.

27. The Jaypee. This is one of the major real estate and construction companies of India which has earned the reputation of constructing major roads and bridges within the stipulated time.

28. Bombay Dying. This is one of the important companies engaged in textile industry and is well known for producing fine as well as cheap and durable bed-sheets and towels. Its products are well renowned in the international markets and are exported to a large number of European and American countries.

29. The Arvind Mills. This is one of the oldest textile mills in India which is engaged in producing and exporting some of the finest and cheapest cotton clothes and garments. This company is one of the largest producers of Jeans cloth and supplies this cloth to almost all the major brands in the world.

30. The Ansals. The Ansals are one of the largest and the oldest real estate developers and their activities can be seen in most of the cities of India.

31. The Pioneer. As the name goes, this company is doing a pioneer job in the development of high yielding varieties of seeds and is promoting hybrid seed-based farming in India. Thus it has played a significant role in the success of the Green Revolution of India. The company is also credited with producing different types of pesticides and herbicides.

32. The Pantnagar. This company is also producing better seeds and helps in the success of the Green Revolution. Apart form seeds, this company produces various pesticides and herbicides.

33. The ACC. This is the organisation of cement producing companies and is known as Associated Cement Company (ACC). It produces high quality cement which has great demand in the market. The company has contributed a lot in boosting the construction activity in the country.

Industrial Complexes

Industries in India are unevenly distributed because geographical, economic and a host of other factories affecting these industries are not evenly distributed. This trend has led to the development of concept of industrial complexes and their growth in different parts of the country. ***An industrial complex consists of a set of specific industries with prominence of production, marketing and other interrelationships among them, strengthened by their togetherness and innovations.*** In simple language, an industrial complex may refer to a factory or collection of buildings relating to industrial production. These complexes have specific geographical locations.

The concept and growth of industrial complexes gained popularity during the communist regime in the erstwhile U.S.S.R. when vigorous industrialization and planning were pursued after taking clues from the planned industrial development in France. This concept is associated with the concept of **'the growth pole'** of Francois Perroux (1955) and 'the growth centre' of J.R. Boudeville (1966). The concept industrial complexes started developing when the governments of various countries started planned economies and paid attention to industrial growth in certain favoured regions. The idea of an industrial complex, as developed by **W. Isard** is a method of analysing the *linkages* between industries in an industrial complex with the objective of identifying the type of industrial complex which would be most suitable for a given development plan or region—it is based on inter-industry relations of *input-output analysis* and *comparative cost analysis*.

In an industrial complex, the finished product of one industry becomes raw material for another industry. For example, automobile industry uses a large number of components which are manufactured by anxillary industries. Thus there is large scale sale and purchase of goods among different industries and their bond becomes stronger. In this way industries of various types play a complementary role in the development of one another. The quality of products is assured from the local industries and transport cost is also minimized. Thus the industries tend to cluster in a particular area and the industries as well as industrial complexes grow fast via the '*spillover effect*' and the '*multiplier effect*' ultimately benefitting the whole economy through the '*trickle down effect*'.

Industrial Complexes in India

There are thousands of industrial complexes which have grown in all the major and minor industrial regions of India. Such complexes may develop in the vicinity of iron and steel plants, and are known as iron and steel complexes. Some of the other complexes are petro-chemical complex, pharma complexes, hosiery complexes, garment complexes, electronic complexes, etc.

The major thrust for developing industrial complexes was given by the central and the state governments after the policy of liberalization and economic reforms was adopted as a result of the Industrial Policy of 1991. The Export Processing Zones (EPZs) and Export Oriented Units (EOUs) of the past and the Special Economic Zones (SEZs) of the present are some of the best examples of Industrial Complexes in India. Besides, Technology Parks, Hardware Parks, Biotechnology Parks etc. are also considered as industrial complexes. These complexes will remain relevant to the industrial growth, till planning is relevant to the economic growth in India.

Problems of Industrial Complexes

In spite of their above mentioned advantages, the industrial complexes have to face several problems, some of which are briefly described as under :

1. It often becomes difficult to select an industry which can attract auxiliary industries and the area may develop into an industrial complex.
2. India has a large number of such industries such as textile mills, paper mills, etc. This leads to break in the chain of *inter-linkage* which puts obstacles in the growth of industrial complexes.
3. Lack of infrastructural facilities, especially the power crisis has done untold damage to the growth of industrial complexes.
4. By and large, the market in India is underdeveloped and lopsided which is hampering the growth and development of the industrial complexes.
5. Indian industrial complexes have to face problems of proper support of external sector regarding imports-exports.
6. Lack of skill on the part of labour and entrepreneurship on the part of industrialists also act as big obstacles in the path of progress of industrial complexes.
7. Usually adequate finances are not available at the right time and industrial complexes have to suffer a great set-back.
8. Labour laws, generally prevailing in India are not conductive to the proper growth of industrial complexes.
9. Wrong selection of 'growth poles' and 'growth centres' often put hindrances in the growth of industrial complexes.

There is an urgent need to offer solutions to the above mentioned problems so that congenial atmosphere is provided for the proper growth of industrial complexes. Economic reforms were initiated in the policy of liberalization adopted in 1991 and some tangible results are visible in the industrial development. Experts are of the view that the industries will grow with the growth of economy and industrial complexes will also grow accordingly.

Public Sector Undertakings

A pubic sector undertaking is an organisation in which the finance, production, sale and management is governed by the Central or State Government. To put in simple words the Government owned corporations are termed as Public Sector Undertakings in India. In a Public Sector Undertaking, majority (51 per cent or more) of the paid-up share capital is held by the Central Government or a Statement Government or partly by the Central Government or partly by one or more State Governments. This is primarily a post-Independence phenomenon as there was virtually no Pubic Sector Undertaking before 1947. A few instances worth mentioning at that time were the Railways, the Post and Telegraphs, the Port Trusts, the Ordinance and Aircraft Factories and a few State managed undertakings like the government salt factories, quinine factories, etc. After Independence, the expansion of pubic sector was considered as an integral part of the 1956 Industrial Policy as this policy gave the public sector a strategic role in the Indian economy.

Immediately after Independence, the Indian economy was in a bad shape—basically an agrarian

economy with a very weak industrial base, large scale unemployment, low level of savings and investment and near absence of infrastructural facilities. Under such circumstances, the Indian economy needed a big push which could come only from the Public Sector Undertakings because private sector was badly lacking in financial resources and managerial ability and was incapable of undertaking risks involved in large and long gestation period investments. At that time, the public sector was thought of as the engine for self-reliant economic growth to develop a sound agricultural and industrial base, diversify economy and overcome economic and social backwardness.

Central Government Enterprises

Table 25.27 shows that the Central Government has played a vital role with regard to public sector undertakings. In the year 1951, the number of enterprises operating was desperately small at 5 with negligibly small investment of ₹29 crores. The corresponding figures reached 22 and ₹6,66,848 in 2011. As on 31st March, 2011, the bulk of investment amounting to 27.83 per cent of the investment was in manufacturing. Even here, the bulk of investment was in basic industries such as iron and steel, coal, power, petroleum, fertilizers, etc. The basic purpose was to facilitate the process of industrialization by establishing heavy and basic industries.

TABLE 25.27. Growth of Investment in Central Government Enterprises

Year (as on March 31)	No. of Enterprises Operating	Total Investment (₹ crores)
1951	5	29
1961	47	950
1980	179	18,150
1990	233	99,330
2001	234	2,74,198
2007	216	4,21,089
2008	214	4,55,367
2009	213	5,13,532
2010	217	5,79,920
2011	220	6,66,848

Source : Government of India, Public Enterprises Survey (2010-11)

Objectives of Public Sector

Following objectives of setting up public sector enterprises have been concerned :

(*i*) to provide rapid economic development through creation and expansion of infrastructure

(*ii*) to generate financial resources for development

(*iii*) to promote redistribution of income and wealth

(*iv*) to create employment opportunities

(*v*) to promote balanced regional development

(*vi*) to encourage the development of small scale and ancillary industries, and

(*vii*) to promote exports on one side and import substitution on the other.

In addition to its major contribution to the industrial growth in the country, public sector has proved to be a great employment provider. Table 25.28 shows that public sector has offered employment to much larger number of people than the private sector. In the year 2001 public sector provided employment to 191 lakh persons in contrast to only 87 lakh persons offered by private sector.

TABLE 25.28. Public and Private Sector Employment in India (in lakhs)

Year	Public sector	Private sector	Total	Pubic sector employment as percentage of total employment
1971	111	67	178	62.4
1981	155	74	229	67.7
1991	190	77	267	71.2
2001	191	87	278	68.7
2005	180	84	264	68.2
2006	182	88	270	67.4
2007	180	93	273	65.9
2008	177	98	275	64.4
2009	178	103	281	63.3
2010	179	108	287	62.4

Source : Data computed from Economic Survey, 2011-12.

However, employment offered by public sector has been varying from 2001 to 2010 whereas employment offered by private sector has been consistently increasing. But employment offered by public sector has never fallen below 62 per cent of the total employment offered by both public and private sector.

Out of total employment of 179 lakh persons in 2010, 11.03 lakh was in mining and quarrying, 10.66 lakh in manufacturing and 8.35 lakh in electricity, gas and water.

Strong Industrial Base by Pubic Sector

It is a well known fact that the pubic sector undertakings laid a solid industrial base in India in the first three decades after Independence. This solid base led to fast industrial growth rate in the country. The Industrial Policy Resolution reserved certain industries such as atomic energy, ammunition and armaments, aircraft, etc. with the government in the interest of national security. The state also took the responsibility for developing key industries like coal, iron and steel, aircraft, ship-building, etc. Setting of integrated iron and steel plants at Durgapur, Rourkela, Bhiali and Bokaro. The Hindustan Machine Tools, locomotives at Chittaranjan and Varanasi are the outstanding examples of contribution by the public sector undertakings towards establishing a strong industrial base in India. Rest of the industries were left to the private sector. But the experience of the first three Five Year Plans made it very clear that private sector was not capable of laying a sound industrial base in the country due some of its inherent handicaps such as lack of capital infrastructure and administrative skill. Simultaneously, the Planning Commission realised that a much more diversified development in the field of industries was necessary if the Indian economy had to become self-generating. Naturally, the government had to undertake the development of basic and strategic industries, capital goods industries and even some consumer goods industries in a big way to boost the Indian economy. Even after the introduction of economic reforms, private sector investment has not increased according to expectations and even now it is being suggested that the pubic sector should take the responsibility of infrastructure development. Consequently, the public sector has entered into a wide spectrum of industries and products. Its operations extend from basic and capital goods like steel, coal, copper, zinc and other minerals, heavy machinery on one hand and drugs, chemicals, fertilizers, consumer goods like textiles, hotel services, watches, bread, etc. on the other hand. Most of these industries are of great strategic importance in the Indian economy because these are industries of high linkage.

In highly critical areas such as copper, coal, petroleum products, hydro and steam turbines the share of public sector is 100 per cent. In quiet a large number of products, it ranges between 50 to 95 per cent.

Removal of Regional Disparities

In addition to industrial growth, public sector undertakings have played a significant role in removing regional disparities in industrial development. With the beginning of the plan period after Independence, care was taken to identify industrially backward regions and pubic enterprises of the Central Government were set-up in those regions. Good example are setting up of three steel plants at Durgapur, Rurkela and Bhilai and Neyveli Project in Chennai. In certain cases, the State Governments could not raise sufficient resources for development of their regions. Under such circumstances, the only alternative available was the setting up of projects by the Central Government or to start enterprises which were financed by the centre. In the recent past, the Central Government had prepared an exhaustive plan to remove industrial backwardness of the north-eastern states and bring them in the main stream of the nation so far as industrial development is concerned.

Shortcomings of the Public Sector

Inspite of the fact that public sector undertakings have contributed a lot to the industrial development of India, there is lot of criticisms on account of the following shortcomings.

(*i*) **Mounting losses.** A review of the public sector enterprises reveals that most of them are running heavy recurrent accumulation of losses and very few are making little or no gain. This may be attributed to a large number of factors including subsidies.

(*ii*) **Political interference.** Often powerful politicians influence decisions regarding setting up of an industry in an area which is not suitable for that particular industry from the geographic and economic point of view. Such a situation results in high input, low output and considerable wastage of financial and human resources. A classic example of this type of political influence is the irrational approach in the decision of the Central Government to break up the MIG aircraft project into two parts to be located in two separate states. One of the project is at Nashik in Maharashtra and the other is at Karaput in Odisha. This was done to appease the political losses of these two states.

(*iii*) **Delays in Completion of Projects.** Since the government machinery has its own way of working which is slow and inefficient, there are often prolonged delays in completion of the projects. This results in colossal loss of resources and escalates the cost of construction due to high rate of inflation.

(*iv*) **Over-capitalisation.** Most of the public sector projects are plagued with over-capitalisation which means that input-output ratios is unfavourable. Some of the public sector undertakings facing this problem are Heavy Engineering Corporation, Hindustan Aeronautics, Fertilizer Corporation etc. According to a report of the Study Team on Public Sector Undertakings (1967), "The cause leading to over-capitalisation can be traced to inadequate planning, delays and avoidable expenditure during construction, surplus machine capacity, tied aid resulting in the compulsion to purchase imported equipment on a non-competitive basis, expensive turn key contracts, bad location of projects and the provision of housing and other amenities on liberal scale."

(*v*) **Price Policy.** Prices of most of the commodities produced by pubic sector undertakings are fixed by the Government and these price are fixed not based on the principle of profit maximisation, rather they are fixed keeping the pubic interest in mind. For example, fixing the prices of steel, oil, gas, coal, fertilizers and other essentials of everyday use will be suicidal for the overall growth of economy. Some times the prices of final products are fixed under public and political pressure.

(*vi*) **Excess of manpower.** In most of the public sector enterprises, recruitment of manpower is often in excess of actual requirement which is putting heavy strain on the input costs. On the other hand, low wages and lack of incentives are causing large scale flight of efficient and intelligent personnel from the public sector to the private sector. The Sixth Pay Commission has substantially raised emoluments of the executives and the Seventh Pay Commission is expected to further enhance their emoluments. This already has and is likely to check the shift from public to private sector.

In order to make pubic sector enterprises economically more effective, the Government has been shedding surplus workers in this sector. As a result of this policy, total number of employees in the Central Public Sector Enterprises declined from 19.92 lakh in 2001-02 to 16.14 lakhs in 2006-07.

(*vii*) **Under-Utilisation of Capacity.** There is a serious problem of under-utilisation of capacity in public sector enterprises. During 2005-06, out of 203 manufacturing/producing units, 103 units or 51% units had recorded capacity utilisation more than 75 per cent. On the other hand, 33 public sector enterprises operated in the capacity utilisation range of 50 to 75 per cent and 67 functioned below 50 per cent of the rated capacity. There is urgent need to investigate into the causes of such a situation and find remedial measures.

(*viii*) **Inefficient management.** There is a serious crisis of inefficient management in almost all the public sector enterprises. This is largely due to strict government rules, lack of elasticity and concentration of power in the hands of a few top executives. Each and every worker should know his responsibility. Unfortunately, there is a general failure to define responsibilities and duties in public sector enterprises in India.

INDUSTRIAL POLICY

'Industrial policy' is a comprehensive concept which coves all those procedures, principles, policies, rules, and regulations that control the industrial undertakings in the country and shape the patterns of industrialisation. It incorporates fiscal and monetary policies, the tariff policy, labour policy and the Governments attitude not only towards external assistance but the pubic and private sectors also.

Industrial Policy Resolution, 1948

The first industrial policy was announced by he Government of India on August 6, 1948. It contemplated a mixed economy in which both pubic and private sectors were involved for the purpose of industrial development. In accordance with this approach, industries were divided into following four broad categories :

(*i*) **Exclusive monopoly of the Central Government.** This included manufacture of arms and ammunition, the production and control of atomic energy and ownership and management of railway transport.

(*ii*) **State monopoly of New Units.** This category covered coal, iron and steel, aircraft manufacture, ship-building, manufacture of telephone, telegraph and wireless apparatus (excluding radio receiving sets) and mineral oil. New undertakings in this category could be undertaken only by the State.

(*iii*) **State Regulation.** This category included industries of such basic importance like machine tools, chemicals, fertilizers, non-ferrous metals, rubber manufactures, cement, paper, newsprint, automobiles, electric engineering, etc. which the Central Government would feel necessary to plan and regulate.

(*iv*) **Unregulated Private Enterprise.** This category of industries was left open to the private sector, individual as well as co-operative.

Industrial Policy Resolution, 1956

Significant development took place after the adoption of 1948 Industrial Resolution. The economic planning had proceeded on an organised basis and the First Five Year Plan had been completed. These important developments made it necessary to come out with fresh statements of industrial policy. Consequently a second Industrial Policy Resolution was adopted in April, 1956. Following were its important provisions.

(*i*) **New Classification of industries.** Industries were divided into following three categories :

(*a*) ***Schedule A.*** These were exclusive responsibility of the state and included seventeen industries *viz.*, arms and ammunition, atomic energy, iron and steel, heavy castings and forgings of iron and steel, heavy machinery required for iron and steel production, for mining, for machine tool manufactures, etc., heavy electrical industries, coal, mineral oils, mining, iron ore and other important minerals like copper, lead, zinc; aircraft, air transport, railway transport, ship-building, telephone, telegraph and wireless equipment, generation and distribution of electricity.

(*b*) ***Schedule B.*** These were to be progressively state owned and in which the state would generally set-up new enterprises, but in which private enterprise would be expected only to supplement the efforts of the state. It included twelve industries *viz.* other mining industries, aluminium and non-ferrous metals not included in Schedule A, machine tools, ferro alloys and tool steels, the chemical industry, antibiotics and other essential drugs, fertilizers, synthetic rubber, carbonization of coal, chemical pulp, road transport and sea transport.

(*c*) ***Schedule C.*** It included all remaining industries and their future development, in general, would be left to the initiative and enterprise of the private sector.

(*ii*) **Fair and non-discriminatory treatment for the private sector.** The state was supposed to facilitate and encourage the development of industries in the private sector by ensuring the development of transport, power, and other services and by appropriate fiscal and other measures without any discrimination.

(*iii*) **Encouragement to village and small-scale enterprises.** The state would take appropriate steps to encourage village and small scale industries.

(*iv*) **Removing regional disparities.** Special emphasis was laid on developing industries in industrially backward areas so that those area as well the whole country is benefited.

(*v*) **Attitude towards foreign capital.** Keeping in view limited resources within the country, it was felt that there was need for securing the participation of foreign capital and enterprise particularly as regards to industrial technique and knowledge so as to foster the pace of industrialisation.

Industrial Policy Statement 1977

With the defeat of Congress Party in 1977, Janata Party came to power and announced its own New

Industrial Policy on December, 1977. Following were the main elements of this policy :

1. Development of Small Scale Sector. It was felt that the policies gave priority to large scale industries at the cost of small-scale industries. Thus the main thrust of this policy was on effective promotion of cottage and small-scale industries which are widely dispersed in rural areas and in small towns. Small-scale sector was classified into the following three categories :

(*a*) Cottage and household industries which provide self-employment on a wide scale.

(*b*) Tiny sector incorporating investment in industrial units, in machinery and equipment upto ₹ 1 lakh.

(*c*) Small-scale industries comprising industrial units with an investment upto ₹ 10 lakhs and in case of ancillaries with an investment in fixed capital upto ₹ 15 lakhs.

2. Areas for Large-Scale Sector. Large-scale industries were divided into the following sectors for their proper development :

(*a*) basic industries such as steel, non-ferrous metals, cement and oil refineries.

(*b*) capital goods industries for meeting the machinery requirements of basic industries and small scale industries.

(*c*) high technology industries which required large-scale production and which were related to agricultural and small-scale industries development such as fertilizers, pesticides and petrochemicals, etc.

(*d*) other industries.

The other elements of this industrial policy were :

3. Rational approach towards large business houses.

4. Expanding role of public sector which includes development of wide range of ancillary industries and decentralization of production.

5. Restricted role of foreign collaboration.

Industrial Policy of 1980

The Janata Party Government at the centre was dislodged by the Congress Party Government which announced its own industrial policy in July, 1980. This policy suggested the following measures :

(*i*) Effective operational management of the Public Sector.

(*ii*) Integrating industrial development in private sector by promoting the concept of economic federalism.

(*iii*) Redefining small scale units as per following divisions :

(*a*) to increase the limit of investment in the case of tiny units from ₹ 1 lakh to ₹ 2 lakhs.

(*b*) to increase the limit of investment in case of small-scale units from ₹ 10 lakhs to ₹ 20 lakhs; and

(*c*) to increase the limit of investment in the case of ancillaries from ₹ 15 lakhs to ₹ 25 lakhs.

(*iv*) Regularisation of unauthorised excess capacity installed in private sector.

(*v*) Automatic expansion of all industries specified in the First Schedule of 1951 Industrial Development Regulation Act.

(*vi*) Revival of those sick industrial units which showed the requisite potential.

Industrial Policy of 1991

A major shift in the industrial policy was made by the Congress Government led by Mr. P.V. Narasimha Rao on July 24, 1991. The main aim of this policy was :

(*a*) to unsackle the Indian industrial economy from the cobwebs of unnecessary bureaucratic control.

(*b*) to introduce liberalisation with a view to integrate the Indian economy with the world economy,

(*c*) to remove restrictions on direct foreign investment as also to free the domestic entrepreneur from the restrictions of MRTP (Monopolies and Restrictive Practices Act) and

(*d*) the policy aimed to shed the load of the public enterprises which have shown a very low rate of return or were incurring losses over the years.

Keeping in view the above mentioned aims, the following initiatives were taken :

1. Industrial Licensing Policy
2. Foreign Investment
3. Foreign Technology Policy
4. Public Sector Policy
5. MRTP (Monopolies and Restrictive Practices Act

1. Industrial Licensing Policy

The industrial licensing policy was framed with respect to the following :

(*a*) Industrial licensing to be abolished for all projects except for a short list of industries related to security and strategic concerns, social reasons, hazardous chemicals and overriding environmental reasons and items of elitists consumption. Industries reserved for the small-scale sector will continue to be so reserved.

(*b*) Areas where security and strategic concerns predominate, will continue to be reserved for public sector.

(*c*) In projects where imported capital goods are required, automatic clearance will be given in cases where foreign exchange availability is ensured through foreign equity. In other cases, imports of capital goods will require clearance from the Secretariat of Industrial Approvals (SIA) in accordance with the availability of foreign exchange resources.

(*d*) In locations other than cities of more than one million population, there would be no requirement for obtaining industrial approval from the central government except for industries subject to compulsory licensing. In respect of cities with population larger than one million, the industries other than non-polluting such as electronics, computer software, and printing will be located outside 25 km of the periphery, except in prior designated industrial areas.

2. Foreign Investment

For encouraging foreign investment in high priority industries, requiring large investments and advanced technology, it was decided to provide approval for direct foreign investment upto 51 per cent foreign equity in such industries.

3. Foreign Technology Policy

For improving the level of technology in Indian industry, the government proposed to provide automatic approval for technology agreements related to high priority industries within the specific parameters. No permission is required for hiring of foreign technicians, foreign testing of indigenously developed technologies.

4. Public Sector Policy

By and large public sector enterprises have given very small returns in proportion to the investment made in such enterprises largely due to their inefficient functioning and also due to take-over of sick private units. Thus they become a liability rather than an asset to the Government. The 1991 Industrial Policy adopted a new approach to public sector enterprises. The following areas were given priority for the future growth of public sector enterprises.

(*a*) Essential goods and services.

(*b*) Exploration and exploitation of oil and mineral resources.

(*c*) Technology development and building of manufacturing capabilities in areas which are crucial in the long-term development of the economy and where private sector investment is inadequate.

(*d*) Manufacture of products where strategic considerations predominate such as defence equipment.

5. MRTP (Monopolies and Restrictive Practices) Act

With the growing complexity of the Indian industrial structure and increasing need for achieving economies of the scale for ensuring higher productivity and competitive advantage in the international market, the interference of the Government through the MRTP Act was to be restricted. To meet this end :

(*a*) The pre-entry scruiting of investments or decisions by the so called MRTP companies

will not be required. Instead, the emphasis will be on controlling and regulating monopolistic, restrictive and unfair trade practices rather than making it necessary for monopoly houses to obtained prior approval of the Central Government for expansion, establishment of new undertakings, merger, amalgamation and take over and appointment of certain directors.

(*b*) The thrust of the policy will be more on controlling unfair or restrictive business practices.

MULTINATIONAL COMPANIES (MNCs)

Induction and Definition

A multinational company/corporation is an organisation which has one its headquarters in one country but has business in more than one country. In other words it is an organisation or enterprise carrying business not only in the country where it is registered but also in several other countries. It may also be called as international corporation, global giant and transnational corporation. According to the most widely accepted definition, an international company is that organisation which produces at least 25 per cent of its global investment outside its original country.

According to the United Nations, a multinational corporation is "an enterprise which owns or controls production or service facilities outside the county in which it is based." In words of W.H. Morcland, "Multinational Companies/Corporations are those enterprises whose management, ownership and controls are spread in more than one foreign country."

Characteristics of MNCs

1. Large Size. MNCs are generally of large size with assets worth billions of dollars and their annual sales turn over is usually more than the gross national product of many small countries.

2. Worldwide Operations. As mentioned earlier a MNC has business in more than one country and often it spreads over a large number of countries. For example, Coca Cola has its branches in more than seventy countries.

3. International Management. MNCs have management at the international level. They operate on the basis of best possible alternative available anywhere in the world. Its local subsidiaries are generally managed by the people of the host country. For example, the management of Hindustan Lever lies with Indians whereas the parent company Unilever is in the U.S.A.

4. Mobility of Resources. Operations of MNCs involve the mobility of capital, technology, entrepreneurship and other factors of production across the territories.

5. Integrated Activities. A MNC is usually a complete organisation comprising manufacturing, marketing, research and development (R&D) and other facilities.

6. Several Forms. A MNC may operate in host of countries in several forms *i.e.* branches, subsidiaries, franchise, joint ventures, etc.

Origin and Growth. MNCs started functioning even before the process of colonisation in the world by the European nations. East India Company was set-up in India before the British rule could establish itself in the country. Similarly the Dutch East Indonesian Company, the Royal African Company and the Hudson Bay Company started their business in early phase of the period of colonisation. Their main purpose was to find out new markets in different countries and exploit their potential. These companies started procuring raw materials from their markets to feed their industries at home. At the same time they found ready market for their furnished products in the countries under their control. Thus a totally new economic and political system was evolved and the era of colonisation began.

After the Second World War, most of the colonial countries became independent nations and started developing their own economies. During this period, the U.S.A. become the world's largest industrial nation and started spreading its influence in larger parts of the world through Direct Foreign Investment. So far so, the U.S.A. became a net investor in addition to being a major exporter.

According to estimates made by the U.N.O., about 35,000 corporates have nearly 1,70,000 companies doing business in countries other than their own country.

TABLE 25.29. Top Ten Multinational Companies in India

Name	Corporate Office	Turn Over (Billion dollars)	Employees	Business
1. Microsoft	Redmond, Washington, U.S.	74	97,000+	Software
2. IBM	Armonk, New York	107	4,34,246	Computer hardware, software, IT services and consulting.
3. Nokia Corporation	Espoo, Finland	39	97,800+	Telecommunications, equipment, Internet, Software.
4. Pepsi Co.	New York, U.S.A.	67	2,97,050+	Food and Beverage
5. Nestle	Vevy Switzerland	86	3,25,000	Food processing
6. Ranbaxy Laboratories Ltd.	Gurgaon Haryana (India)	2	10,000	Pharmaceuticals
7. Coca Cola	Midtown Atlanta Georgia	—	1,50,500+	Beverage
8. Procter & Gamble	Cinceinnati, Ohio, USA	84	1,25,000+	Consumer goods
9. Sony Corporate	Minato Takyo, Japan	80	1,62,000+	Conglomerate Corporation
10. Citigroup Inc.	Manhattan, New York, U.S.A.	70	2,58,500+	Banking and Financial services

Source : https/www.google.co. In/search.

The quantum of business carried on by them can be judged from the fact that in 1998 about 200 big Multinational companies of the world accounted for 28.3 per cent of the world's GDP. Currently, their total sales are equivalent to the GDP of 182 countries of the world (excluding the U.S.A., Japan, Germany, France, Britain, Brazil, Canada, China and Italy).

Effects of MNCs. MNCs have both good and bad effects in India. For example, most industries were producing consumer goods at the time of Independence. There were only three iron and steel companies (TISCO, IISCO and MISCO) and capital goods were almost absent. At present, India has developed almost all types of Industries largely with the help of foreign finances, technology and expertise. In spite of all these achievements, MNCs are not flawless and have their own ill effects. In the year 1975-76, Dr. S.K. Goel studied 133 out of 171 companies and arrived at certain conclusions. Some of the conclusions can be summed up as follows :

1. Capital Investment. Some MNCs made some capital investment in the beginning to exploit the rich natural resources of India.

2. New Technology. Before Independence, most industries in India were using old and obsolete technology which gave low level of production of inferior goods. MNCs introduced new advanced technology to Indian industries which improved the quality of industrial products and also helped in increasing their production.

3. Damage to Cottage and Small-Scale Industries. India had a rich tradition of cottage and small-scale industries which were based on traditional methods of production. These industries could not compete with modern industries of MNCs which started producing better goods in larger quantities and at cheaper prices. Thus these industries suffered a great set-back at the hands of MNCs and may totally disappear in future if proper steps are not taken to safeguard the interest of these industries.

4. Low Level of Foreign Investment. Dr. S.K. Goel has rightly pointed out that most foreign subsidiaries have raised financial resources from within India by exploiting the natural resources of the country. Thus MNCs invested very little capital form their parent countries and total foreign investment has been only marginal.

5. Multi-Industry Pattern. Many MNCs have acquired multi-product and multi-industry pattern adding considerably to their original industry. For

example, the Imperial (now India) Tobacco Company (ITC) has diversified its activities and ventured into hotel industry, constructing a chain of hotels in different parts of the country. This company has also entered into some allied industries such as salt, flour, biscuits, match boxes, agarbathi, etc.

6. Heavy Remittance Abroad. According to the Reserve Bank of India, 537 foreign companies have reported average rate of profit at 23.8 per cent during the period 1972 to 1993. This rate is reported to have increased to about 25 per cent now. This is a huge amount of money remitted outside the country causing heavy strain in India's economic resources.

7. Transfer of Technology—A Myth. According to Dr. S.K. Goel, 'the assumption that entry of multinational corporations would ensure transfer of latest sophisticated technology to developing countries has not been found valid in practice and has proved to be a myth.

LIBERALISATION

Liberalisation means to liberate the Indian industries from undue interference of the government agencies and to remove the bureaucratic control which have been hampering the proper growth of industries in the country. It was also aimed at enabling the Indian industries to successfully face the market forces and provide guidelines for their future growth. The process of liberalisation started on 24th July, 1991 when Dr. Manmohan Singh, the then Finance Minister in Mr. P.V. Narasimha Rao ministry introduced the new Industrial Policy. Following are the salient features of policy of liberalisation.

1. Under the policy of liberalisation, the bureaucratic control on the industries was removed as it was creating barriers in the industrial development in the country. As a matter of fact, this policy implies deregularisation of the industrial sector by cutting down the minimum administrative interference in operation, instead, letting the market forces operate through the profit motive of the producers and free competition among them to regulate and guide the future development of the industry sector.

2. The Industrial Policy of 1991 was slightly modified in March, 1993 according to which requirement of industrial licensing was abolished except for 18 industries namely, (1) coal and lignite, (2) petroleum (other than crude) and its distillation products, (3) distillation and brewing of alcoholic drinks, (4) sugar, (5) animal fats and oils, (6) cigars and cigarettes of tobacco and manufactured tobacco substitutes, (7) asbestos and asbestos based products (8) plywood, decorative veneers and other wood based products like particle board, medium density fibre board, black board, (9) raw hides and skins, leather, chamois leather and patent leather, (10) tanned or dressed furskins, (11) motor car, (12) paper and newspaper except bagasse-based units, (13) electronic aerospace and defence equipment—all types, (14) industrial explosives, including detonating fuse, gun powder, nitrocellulose and matches, (15) hazardous chemicals, (16) entertainment electronics (VCRs) Colour TVs, CD players, tape recorders), (17) drugs and pharmaceuticals and (18) white goods (domestic refrigerators, domestic dish washing machines, programmable domestic washing machines, microwave oven, airconditioners).

3. Gates for direct foreign investment (DFI) were opened and subsidies were reduced.

4. Restriction on export and import of a large number of items were abolished.

5. Import tariffs were substantially reduced and restrictions of foreign investment were totally removed.

6. The government share in industries was restricted to 51 per cent and the process of disinvestment in public sector was initiated. This led to reduction of delays in taking decisions at the government level and the industrialists become free to take their own-decisions without any loss of time.

7. Under the policy of liberalisation, the industrialists were encouraged to take active part in the fields of road, power, communication and petroleum so that centre and state governments could pay more attention to social and economic development programmes.

Impact of Liberalisation

Liberalisation has left both good and bad effects on Indian economy.

Good Effects

Indian economy in general and industries in particular have been benefited a lot by the policy of liberalisation as is clear from the following few points :

1. Increase in Foreign Direct Investment (FDI). The policy of liberalisation has provided congenial atmosphere for investment and given a boost to FDI. This provides great opportunities for development of industries and other spheres of economy. From a meager amount of ₹ 534.11 crore in 1991, the cumulative FDI flow from April, 2000 to November, 2012 stood at US $ 277.86 billion. During 2012-13, services, hotels and tourism, metallurgical industries, automobile industry, construction, drugs and pharmaceuticals, industrial machinery were the sectors that attracted maximum FDI inflows. In FDI equity investments, Mauritius tops the list of first ten investing countries, followed by Singapore, the U.K., Japan, the U.S. the Netherlands, Cyprus, Germany, France and the U.A.E.

2. Increase in GDP (Gross Domestic Product). There had been significant increase in GDP after the policy of liberalisation was adopted by the government. In the year 1991, GDP was ₹ 6,92,871 crore which rose to ₹ 1,00,28,118 crore in 2012-13.

3. Reduction in Industrial Recession. Before liberalisation, Indian industries were passing through the phase of recession. Foreign investment and technology started flowing in immediately after adoption of policy of liberalisation. Old industries were rejuvenated and new industries were established. All these developments resulted in reduction of recession. In 1991, Indian industries faced serious recession but its effect was reduced to a great extent by 1994. Industrial index increase from 4 per cent in 1994 to 12 per cent in 1995-96. Industries like automobiles, autoparts, coal mining, consumer electronics, textiles, petrochemicals, software, sports-goods recorded a growth rate of 20 per cent in 1994. Besides, fertilizers, crude oil, tyres, tubes, etc. also recorded a 10 per cent growth at the same time. In the year 2007-08, the whole world was passing through a serious economic recession but India was one of the least effected nations in the world. However, some slowdown in the Indian industrial growth rate has been observed in the recent past. For example, growth rate in manufacturing fell from 9.0 per cent in 2010-11 to 3.0 in 2011-12. With 100 as base in 2004-05, the general index of industries increased to 172.1 in 2013-14.

4. Increase in employment. Liberalisation has opened the doors for domestic and foreign investment amounting to over ₹ three lakh crores. This will definitely strengthen the industrial base in the country and create 32 lakh jobs.

5. Development of Infrastructure. Before liberalisation, major components of infrastructure such as transport and electricity were in a bad shape and were adversely affecting the economic growth in general and industrial growth in particular. Liberalisation provided congenial atmosphere for heavy investment in infrastructure which facilitated the rapid economic and industrial growth in the country.

6. Rise in Exports. Liberalisation led to economic and industrial growth which in turn, boosted India's exports considerably. For example, India's total exports amounted to ₹ 32,553 crores in 1990-91 which rose to ₹ 18,94,182 in 2013-14.

Bad Effects

Although liberalisation has helped in developing economy and has led to industrial growth, it has its own bad effects, some of which are briefly described as under :

1. Increase in Regional Disparities in Industrial Growth. The policy of liberalisation and New Industrial Policy have increased the pre-existing regional disparities instead of reducing them. Both the Indian and the foreign investors invested money only in those regions which were already advanced from the industrial point of view. The maximum investment was made in industrially advanced states of Maharashtra, Gujarat, Rajasthan, West Bengal, Andhra Pradesh, Tamil Nadu and Karnataka and industrially backward states like Bihar, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Meghalaya, Mizoram, Tripura, Nagaland, Odisha, Uttar Pradesh, etc. are lagging behind. In the year 1994, Maharashtra was at the top with an investment of ₹ 3,744.71 crores. West Bengal with ₹ 2,844 crores was at the second place. **Ghum** and **Ghuman** recognised four regions with respect to investment. These are : (*i*) Maharashtra-Gujarat, (*ii*) Andhra Pradesh, Tamil Nadu, Karnataka, Madhya Pradesh and Odisha, (*iii*) Haryana and Rajasthan and (*iv*) West Bengal. Uttar Pradesh, Himachal Pradesh,

Uttarakhand and Bihar are the least benefited states. Increase in regional disparities has given birth to a large number of socio-economic and political problems. The Naxal Movement in a large number of states extending from Darjeeling in West Bengal to Kanniyakumari in Tamil Nadu. ULFA in Assam, and political turmoil in Jammu and Kashmir may be partly explained due to regional disparities in industrial growth.

2. Increase in Regional Disparities in Infrastructure. Along with regional disparities with respect to industrial growth, regional disparities in infrastructural development have also increased. For example, out of 33 sanction electricity projects (based on coal, gas lignite and water) in 1994, the state-wise sanction was 6 to Odisha, 5 in Karnataka, 3 each to Tamil Nadu, Andhra Pradesh and Maharashtra, 2 each to Haryana, West Bengal and Andhra Pradesh and the remaining seven were sanctioned to other states. Madhya Pradesh, Uttar Pradesh, Bihar, Mizoram, Nagaland, and Delhi were totally deprived of these projects.

3. Damage to Cottage and Small-scale Industries. A developing country like India has an old and rich tradition of cottage and small-scale industries. These industries form an important segment of our economy and provides employment to millions of artisans at the village level. Liberalisation opened the floodgates for investment by Indian as well as foreign companies in large scale industries. This give much need boost to large-scale industries but cottage and small-scale industries suffered heavily because they could not compete with rich financial and technological resources of big companies. The revival of these industries requires help from the government in the form subsidies, technology, and proper facilities for exports.

4. Increase in Unemployment. Although liberalisation facilitated the smooth flow of foreign investment, it also encouraged the use of labour saving new work efficient technology. Thus in spite of heavy investment and rapid increase in industrial production, the employment opportunities were drastically reduced and unemployment increased.

5. Comparatively Little Direct Investment. The foreign investors are more interested in portfolio investment rather than in direct investment. The main reason for such a situation is portfolio investment can be withdrawn at will without much hurdles, thus adversely affecting the economy of the country.

6. Problem of Inflation. Since the adoption of policy of liberalisation, the rate of inflation has been almost consistently high, sometimes soaring to double digits. This often upsets the budget of a middle class family. Moreover, money is concentrated to a few rich persons and the gap between the poor and the rich widens. This type of situation creates a lot of economic and social problems often leading to social tension.

7. Excess of foreign money. Liberalisation has allowed large scale inflow of foreign money which could not be properly invested due to low level economy and poor base in the country. Investment for exports is limited and foreign trade is adversely affected.

8. Investment in Selected Industries. Most of the foreign investment comes to white-goods instead of wage-goods sector. Thus it may be useful in improving the high priority sector and bringing in the latest technology while ignoring the other sector. This can be counterproductive and is not in the interest of overall economic development.

9. Economic and Political Freedom at Stake. Liberalisation attracts more and more of foreign investment also involving a lot of foreign exchange. Thus there is a danger that the whole economy may be handed over to the multinationals putting our economic and political freedom of a great risk.

10. Agriculture is ignored. Liberalisation has given impetus to industries but has badly ignored agriculture. Agriculture is the **'back-bone'** of our economy which provides livelihood to more than 55 per cent of our population. If the trend of encouraging industries at the cost of agriculture continues unabated it will bring imbalance in the economy and the country will be confronted with a serious economic crisis.

SPECIAL ECONOMIC ZONE (SEZ)

Introduction and Definition

Special economic zone (SEZ) is a geographical region in which economic laws are more liberal than

laws prevailing in other parts of a country and which is designed to export goods. SEZ may be exempt from laws regarding taxes, quotas, Foreign Direct Investment (FDI) loans, labour laws and other restrictive laws in order to make the goods manufactured in the SEZ at globally competitive price. The SEZ includes Free Trade Zones (FTZ), Export Processing Zones (EPZ), Free Zones (FZ), or Free Economic Zones (FEZ), Industrial Parks or Industrial Estates, Free Parks, Bonded Logistics Parks and Urban Enterprise Zones. The operating definition of an Economic Zone is determined by each country's trade and customs administration. For a well organised SEZ there should be atleast 1000 hectares of land and a minimum investment of ₹ 10,000 crore.

Objectives. SEZ is established with the following objects in mind :

(*a*) Generation of additional economic activity.

(*b*) Promotion of exports of goods and services.

(*c*) Promotion of investment from domestic and foreign sources.

(*d*) Creation of employment opportunities.

(*e*) Development of infrastructure facilities.

Historical Perspective

In the opinion of Robert C. Hayward, Director, World Economic Processing Zones Association, the concept of free economic zones dates back to 300 B.C. He noted that such enclaves were found in the city of tyre in the Greek island of Delos. The city became rich due to such policies and was considered as a challenge to the centralism of the Roman Empire. In the modern context, the most famous SEZs were established by the government of China under Deng Xiaoping in the early 1960s. This was followed by setting up of SEZs in a large number of countries including Brazil, India, Iran, Jordan, Kazakhistan, Pakistan, Philippines, Poland, Russia and Ukraine.

Special Economic Zones of India

India was one of the first countries in Asia to recognise the effectiveness of Export Processing Zone (EPZ) model in promoting exports with Asia's first EPZ set-up in Kandla in 1965. In order to overcome the shortcomings due to multiplicity of controls and clearances, absence of world class infrastructure, and an unstable fiscal regime and for attracting larger foreign investments in India, the Special Economic Zones (SEZs) Policy was announced in April, 2000.

In 2004, the Government of Gujarat, amended the Industrial Disputes Act to create special exemption for SEZs so that companies can terminate work with only one month's notice. This flexibility helped in growing manufacturing jobs in Gujarat by 60% from 2000 till 2012.

The SEZ Act, 2005, was a very important bill passed by the Government of India. This bill was passed with the aim to instil confidence in investors and signal the Government's commitment to a stable SEZ policy regime with a view to impart stability to SEZ regime thereby generating greater economic activity and employment through their establishment. This Act come into effect on February 10, 2006 and provided for drastic simplification of procedures and for single window clearance on matters relating to central as well as state governments. The remaining part of India, not covered by SEZ rules is known as *Domestic tariff area*. Exports from Indian SEZ totalled ₹ 2.2 trillion in 2009-10. It grew by a stupendous 43% to reach ₹ 3.16 trillion in 2010-11. Indian SEZs have generated 8,40,000 jobs as in 2010-11. Despite all odds, exports through Indian SEZs grew further by 15.4% to reach ₹ 3.64 trillion in 2011-12.

INCENTIVES AND FACILITIES TO SEZ DEVELOPERS

- Exemption from customs/excise duties for authorised operations.
- Income Tax exemption on income derived from business of development of SEZ.
- Exemption from minimum alternative tax.
- Exemption from dividend distribution tax.
- Exemption from sales tax.
- Exemption from service tax.

There were 143 SEZs as of June, 2012 operating throughout India. An additional 634 SEZs (as of June 2012) have been formally/principally approved by the Government of India (**Table 25.30**).

TABLE 25.30. Number of Special Economic Zones in India (as of June, 2012)

State/Union Territory	No. of Operational SEZs	No. of SEZs formally approved	Total
1. Andhra Pradesh	36	116	152
2. Tamil Nadu	28	77	105
3. Karnataka	22	60	82
4. Maharashtra	18	119	137
5. Gujarat	13	53	66
6. Kerala	7	29	36
7. Uttar Pradesh	6	35	41
8. West Bengal	5	24	29
9. Rajasthan	4	11	15
10. Haryana	3	2	5
11. Chandigarh	1	2	3
12. Madhya Pradesh	1	17	18
13. Odisha	1	10	11
14. Punjab	0	8	8
15. Goa	0	7	7
16. Chattisgarh	0	3	3
17. Delhi	0	3	3
18. Dadra & Nagar Haveli	0	2	2
19. Nagaland	0	2	2
20. Puducherry	0	2	2
21. Uttarakhand	0	2	2
22. Jharkhand	0	1	1

Source : en-wikipedia.org/wiki/special economic zone#India.

INDUSTRIAL/ECONOMIC CORRIDORS

Industrial/economic are corridors along the main transport routes which have been selected for special thrust to be given for industrial/economic development in the country. The corridors involve multiple development projects including development in transport, socio-economic impact, urban development, environmental management, increase in exports, growth in employment opportunities and above all revolutionise the industrial growth. Currently following four industrial/economic corridors are proposed to be developed (**Fig. 25.17**).

1. Delhi-Mumbai Industrial Corridor (DMIC)
2. Amritsar-Delhi-Kolkata Industrial Corridor (ADKIC)
3. Chennai-Bengaluru Industrial Corridor (CBIC).
4. Bengaluru-Mumbai Industrial Corridor (BMIC)

1. Delhi-Mumbai Industrial Corridor (DMIC). This is the most ambitious industrial development plan of the Government of India for which 'in principle' approval was accorded in August 2007. This 1483 km long industrial corridor will be developed along the *Western Dedicated Freight Corridor* of the Indian railways with view to using the high-capacity of this dedicated freight corridor as a backbone for creating a global manufacturing and investment destination. The project seeks to develop a series of futuristic infrastructure endowed smart industrial cities that can compete with the best international manufacturing and industrial regions. The master plan has a vision for 24 manufacturing

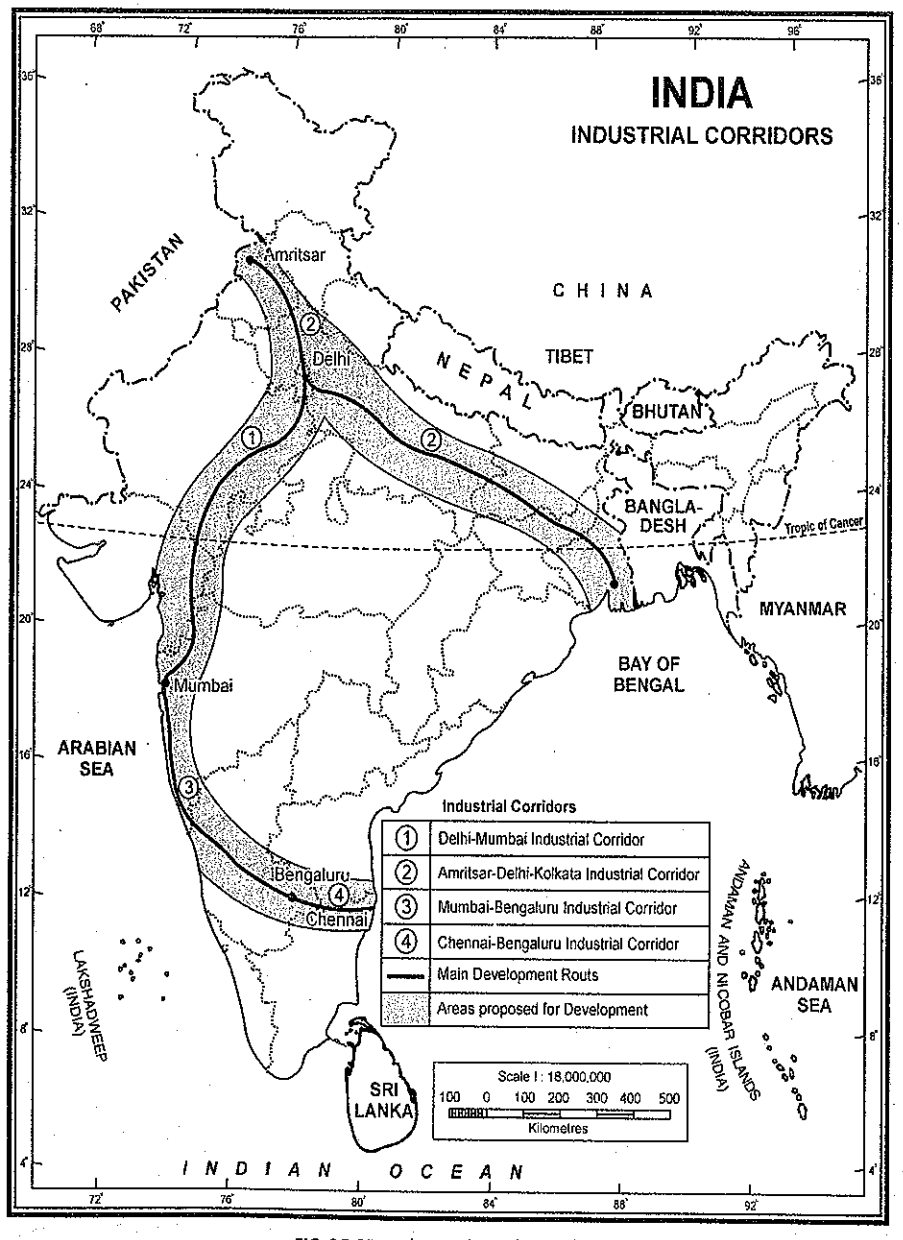


FIG 25.17. India : Industrial Corridors

cities. Potential production sectors include general manufacturing, IT/ITES components, electronics, agro and food processing, heavy engineering, pharmaceuticals, biotechnology, and services. The project involves a total investment of $ 90 billion and will be completed with Japanese assistance.

The project with involve a total area of 4,36,486 sq km which is about 13.8 per cent of the total land area of India. It extends over seven states and two union territories *viz.* Delhi, Uttar Pradesh, Haryana, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Daman and Diu and Dadra and Nagar Haveli (Delhi has been treated as a state in this context). The distribution of length of the corridor indicates that Rajasthan (39%) and Gujarat (38%) together constitute 77% of the total length of the freight corridor followed by Haryana and Maharashtra 10% each and Uttar Pradesh and National Capital of Delhi 1.5% each) About 17 per cent of India's total population will be affected. The projects goals are to double employment potential in seven years, triple industrial output in nine years, quadruple exports from the region in 8-9 years and target 13-14 per cent growth per annum for the manufacturing sector on a sustainable basis. The project is expected to generate employment for 3 million persons. The Western Dedicated Freight corridor will have nine junction stations along which other railroad networks will connect allowing the system to extend its reach across a wide swatch. Other infrastructure plans include logistic hubs, feeder roads, power generation facilities, up-gradation of existing ports and air-ports, developing greenfield ports, environment protection and social infrastructure. It will include three seaports and six airports in addition to connectivity with the existing ports. The major power inputs will come

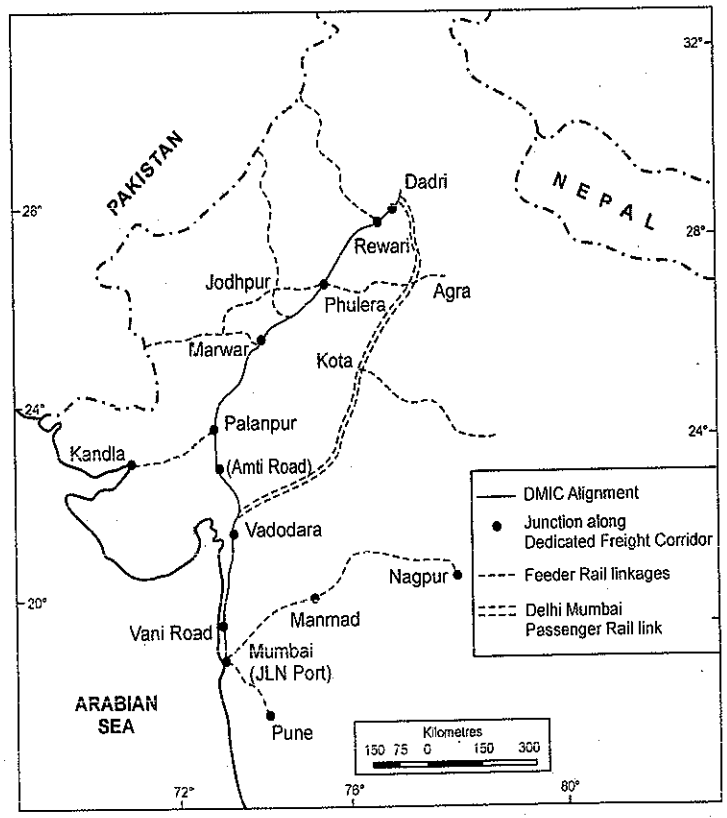


FIG 25.18. Delhi-Mumbai Industrial Corridor

from six gas-based projects of around 1000-12000 MW each. Other power options include the use of renewable energy sources integrated through a smart grid.

The project seeks to upgrade the existing industrial clusters and also develop new industrial facilities. These will be developed on the concept of node-based development based on Investment Regions (IRs) and Industrial Areas (IAs). These are proposed as self-sustaining industrial townships with world class infrastructure. IRs will have a minimum area of 200 sq km and IAs will have 100 sq km. In all 24 IRs and IAs are planned.

Six mega investment regions are Dadri-Noida (U.P.), Manesar-Palwal (Haryana), Khushera-Bhiwadi-Neemra (Rajasthan), Ptampura-Dhar-Mhow (Madhya Pradesh), Bharuch-Dahej (Maharashtra) and Igatpuri-Nashik-Sinnar (Maharashtra) Five industrial areas are Meerut-Muzaffarnagar (Uttar Pradesh), Faridabad-Palwal (Haryana), Jaipur-Dausa (Rajasthan), Vadodara-Ankleshwar (Gujarat) and Alewari-Dighi Port (Maharashtra).

2. Amritsar-Delhi-Kolkata Industrial Corridor. This corridor will be structured around the Eastern Dedicated Freight Corridor (EDFC) and also along the existing highway transport route. It will also leverage the Inland Water Transport System being developed along the Ganga river from Allahabad to Haldia. It will cover the states of Punjab, Haryana, Uttar Pradesh, Uttarakhand, Bihar, Jharkhand and West Bengal. This is one of the most densely populated regions of the world and is the home for about 40% of India's population. It will cover the cities of Amritsar, Jalandhar, Ludhiana, Amabala, Saharanpur, Delhi, Roorkee, Moradabad, Bareilly, Aligarh, Kanpur, Lucknow, Allahabad, Varanasi, Patna, Hazaribagh, Dhanbad, Asansol, Durgapur and Kolkata.

3. Chennai-Bengaluru Industrial Corridor (CBIC). This 560 km long corridor between Chennai-Bengaluru-Chitradurga will benefit the states of Karnataka, Andhra Pradesh and Tamil Nadu. Comprehensive plan for the CBIC was decided in December 2011, and it will be completed with Japanese financial help. Steel, cement, food processing, information technology, automobiles, readymade garments, petroleum, chemicals, and petrochemicals are some of the industries that would be benefited from this corridor. Karnataka government has proposed to extend this corridor upto Mangalore and reposition this corridor as West seaport to East seaport connectivity corridor. A new proposal has been put forward where the corridor will have 2 seaports at the extreme ends and 3 international airports on the way. Commencement of preparatory work for the corridor has been approved in budget announcement for 2013-14. It will boost India's trade with both eastern and western countries.

4. Bengaluru-Mumbai Economic Corridor. Decision to develop this corridor was taken in February, 2013 and will be developed with the financial and technical help from the UK. This corridor is intended to facilitate development of a well-planned and efficient industrial base served by world-class connectivity infrastructure. It will also increase the possibility of private investments in manufacturing and industrial activities in Maharashtra and Karnataka.

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CHAPTER 26

Transport, Communication and Space

INTRODUCTION

Transport is a system in which passengers and goods are carried from one place to another. Development of cheap and efficient means of transport is necessary for the progress of a large and developing country like India. Transport routes are the basic economic arteries of the country. Transport system is regarded as the sinews of the national economy and provides a very important link between production and consumption. The amount of traffic moving in a country is a measure of its progress. In the modern age, even ideas and skills move from one place to another with the help of transport systems.

India is a vast country with long distances from Kashmir in the north to Kanniyakumari in the south and from Kandla in the west to Kohima in the east. She has vast natural resources of great diversity. In addition, India has great diversity in economic, social, cultural and ethnic structure. A well-knit transport system is essential to bring about unity in diversity in the Indian fabric.

All types of transport including railways, roadways, waterways, airways and pipelines are available in India.

RAILWAYS

Indian railway system is the main artery of the country's inland transport. Railways virtually form the life-line of the country, catering to its needs for large scale movement of traffic, both freight and passenger, thereby contributing to economic growth and also promoting national integration. In fact, railways constitute the backbone of surface transport system in India.

Development and Growth of Indian Railways

The first railway line in India was opened for public traffic on 16 April, 1853 between Mumbai and Thane over a distance of 34 km. This line was extended to Kalyan on 1 May, 1854 and to Khopoli

on 12 May, 1856. The Khandala-Pune section was opened to traffic on 14 June, 1858.

Meanwhile, the construction of the railway lines was going on in eastern part of the country and the first section of the East Indian Railway, from Haora to Hugli, a distance of 37 km was inaugurated on 15 August, 1854. The Haora-Hugli section was extended to Pundooah on 1 Sept, 1854 and to Raniganj Coal Mines on 3 Feb, 1855. The line from Kanpur to Allahabad was opened in 1859 and the Haora-Khana-Rajmahal section was completed in 1860. Mughal Sarai also appeared on the railway map of India in 1862. In 1860, the Kanpur-Etawah section was opened to traffic and between 1862 and 1866, all the gaps between Haora and Delhi were filled.

The southern part of the country did not lag behind and got its first 105 km long railway line from Royapuram to Arcot in 1856. This line was extended to Kadalundi (near Calicut) on the west coast in 1861. The Jolar Pettai-Bangalore Cantonment section was opened in 1864.

In 1870, the all-rail route between Kolkata and Mumbai started functioning and the main line from Mughal Sarai to Lahore (now in Pakistan) was completed. In 1871, the Mumbai-Chennai route was also opened. Thus within a short span of 18 years from 1853 to 1871, most of the important cities of India were connected by rail. The total route kilometreage in 1870 was 7,680 km which rose to 39,834 km by the turn of 19th century and to 66,234 by 31 March, 1940. As on 15 August 1947, Indian Railways consisted of 65,217 km out of which 10,523 km went to Pakistan, leaving India with 54,694 km.

Phenomenal growth of Indian Railways has taken place in the post-Independence era as is clear from **table 26.1**.

At present, India has the second largest railway network in Asia and the fourth largest in the world after the USA (2,27,736 km), Russia (2,22,293 km), and China (87,157 km). But India tops world's leading countries with regard to passenger/kilometre carried. It is the largest public sector undertaking of the country comprising a vast network of 7,146 stations spread over a route length of 64,600 km with a fleet of 9,549 locomotives, 55,339 passenger services vehicles, 6,560 other coaching vehicles and 2,39,321 vagons as on 31st March, 2012. The growth of Indian Railways since its incaption in 1853 has been phenomenal. It has played a vital role in the economic, industrial and social development of the country.

Factors affecting Railways

The pattern of Indian railway network has been influenced by geographical, economic and political factors.

TABLE 26.1. Progress of Railways in India

Year	Route-length (kilometre)			Running track (kilometres)		
	Electrified	Non-electrified	Total	Electrifield	Non-electrified	Total
1950-51	388	53,208	53,596	937	58,378	59,315
1960-61	748	55,499	56,247	1,752	61,850	63,602
1970-71	3,706	56,084	59,790	7,447	64,222	71,669
1980-81	5,345	55,895	61,240	10,474	65,386	75,860
1990-91	9,968	52,399	62,367	18,954	59,653	78,607
2000-01	14,856	48,172	63,028	27,937	53,928	81,865
2007-08	18,274	44,999	63,273	34,700	50,458	85,158
2008-09	18,559	45,456	64,015	35,471	51,466	86,937
2009-10	18,927	45,047	63,974	35,811	57,276	87,087
2010-11	19,607	44,863	64,460	36,000	51,040	87,040

Source : Data computed from Statistical Year Book, India, 2013.

1. Geographical factors. The North Indian plain with its level land, high density of population and rich agriculture presents the most favourable conditions for the development of railways. However, the presence of large number of rivers makes it necessary to construct bridges which involves heavy expenditure. There are practically no railways in the flood plains of many rivers in Bihar and Assam. The plateau region of south India is not as much suitable for railways as the North Plain area. The Himalayan region in the north is almost entirely devoid of railways due to its rugged topography. Some railway terminals such as Hoshiarpur, Kotdwar, Dehra Dun, Kathgodam, etc. are found on the foothills. Some narrow gauge railway tracks are found in the Himalayan region. A railway link between Jammu and Kashmir valley is being planned at a very high cost. The sandy areas of Rajasthan are also not much favourable for railways. There was no railway line between Jodhpur and Jaisalmer till 1966. Similarly, forested areas of Madhya Pradesh and Odisha, deltaic swamps of West Bengal, marshy areas of Rann of Kachchh and hilly tract of Sahyadri are also unfavourable for the development of railways. Sahyadri can only be crossed through gaps like Thalghat, Bhorghat and Palghat to reach coastal rail heads like Mumbai, Vasco-de-Gama, Mangalore and Kochi. Obviously, the *railways tend to follow the path of least resistance.*

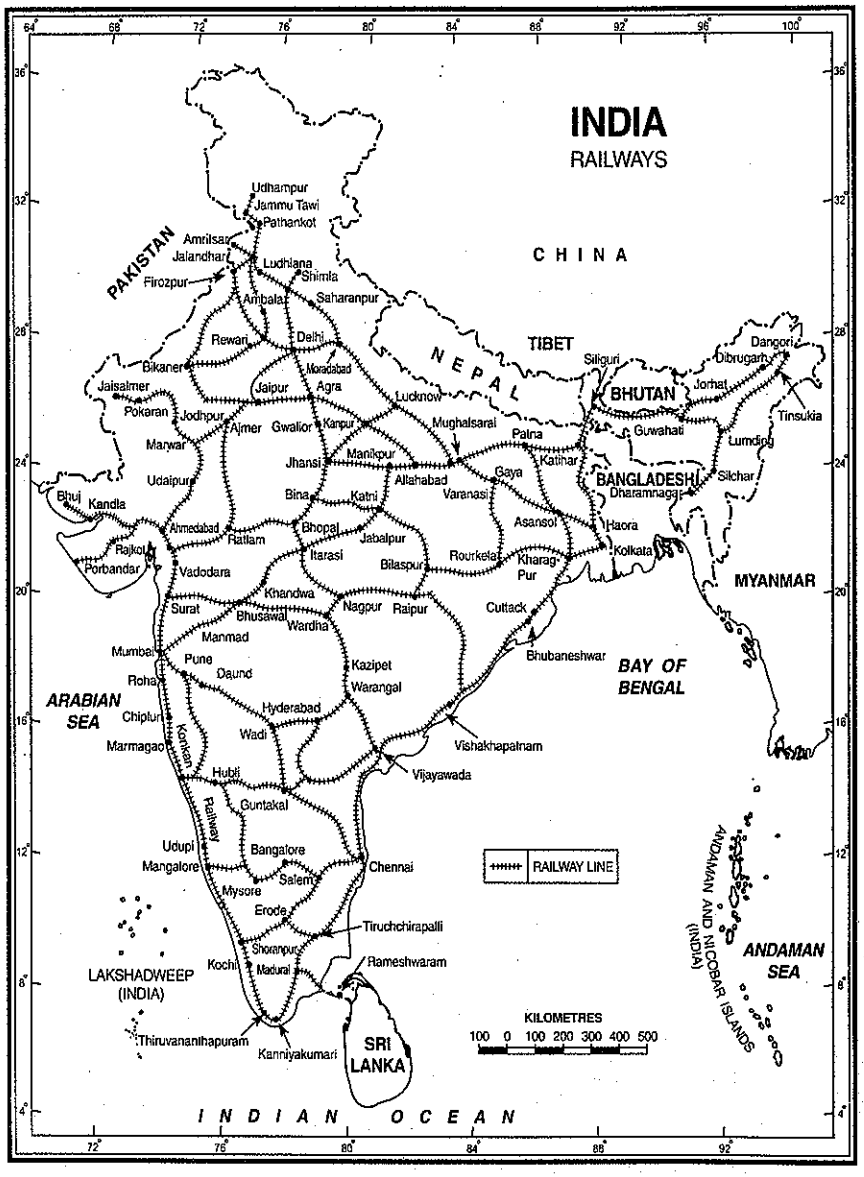

FIG. 26.1. India : Railways

2. Economic factors. Railways develop more in the economically advanced areas where the need for railway network is felt more. Conversely, railways bring economic prosperity to the areas through which they pass. This is because of the economic linkages that we find the highest density of railways near big urban and industrial centres and in areas which are rich in mineral and agricultural resources.

3. Political and Administrative factors. The present railway system in India is the legacy of the British rule. The British administration planned the direction and pattern of the railway lines in such a way that they could exploit the valuable raw materials of India for the benefit of their industries and flood the Indian markets with the finished goods from Britain. Besides, the Britishers wanted to maintain their military supremacy, for which quick movement of troops, arms and ammunition was necessary and construction of railways became unavoidable. Thus, top priority was given to the big ports of Mumbai, Kolkata and Chennai. These ports were connected with their hinterlands by railway lines to facilitate imports and exports. It is from the ports that the railway network spread to the other parts of the country.

Distribution of Indian Railways

Fig. 26.1 shows the following distribution pattern of Indian railways :

1. The North Indian Plain. This region has a dense network of railways from Amritsar to Haora. This is a plain area which is very much suitable for the construction of railways. This densely populated region has highly developed agriculture and industry. Large scale urbanisation has also helped in the development of the railways. The density of railway network is closely related to the agricultural and industrial development. There are a few focal points such as Delhi, Kanpur, Mughal Sarai, Lucknow, Agra and Patna. However, Delhi is the main point from where railway lines radiate in all directions. For political, administrative and economic reasons, Delhi is connected with major ports like Mumbai, Kolkata, Haora and Chennai through superfast trains.

2. The Peninsular Plateau. The whole of Peninsular plateau has hilly and plateau terrain which hinders the development of railways. The population density is also moderate. For such reasons, excepting, Saurashtra and Tamil Nadu, a relatively open and more loose network has developed here. However, some trunk routes cross the peninsula and provide efficient rail service between Mumbai-Chennai, Chennai-Kochi, Chennai-Delhi, Mumbai-Kolkata, Chennai-Hyderabad and Mumbai-Thiruvananthapuram.

3. The Himalayan Region. Railways are conspicuous by their absence in the Hinmalayan region. The rugged terrain, hill and valley topography, backward economy and sparse population are the factors responsible for the sparse rail network in this region. There are only three narrow gauge railway lines in the Himalayan region. These are Kalka-Shimla, Pathankot-Kangra and Siliguri-Darjeeling. The Kalka-Shimla Railway, built in 1903 winds itself through picturesque country from Kalka to Shimla over a distance of 96.6 km. It has 103 tunnels, totalling 8 km in length, the longest tunnel is 1,144 metre. The railway track from Kalka to Shimla passes over 869 bridges. The Siliguri-Darjeeling Railway is 82 km long and was constructed in 1878. There is practically no railway line in the north-eastern states of Meghalaya, Tripura, Arunachal Pradesh, Mizoram, Manipur and Nagaland. These areas have rough terrain covered with thick forests. The population is sparse and the economy is in a backward state. Construction of railways under these conditions is a difficult and costly affair.

However, plans are afoot to provide rail links to Meghalaya, Arunachal Pradesh and Tripura, although at a very heavy cost. A vital rail link to Kashmir valley has already made much headway.

4. The Coastal Plains. There is a distinct contrast in the rail network between eastern coastal plains and western coastal plains. The eastern coastal plain is quite wide and permits the construction of railways, as a result of which, there is a long trunk route along the east coast from Kolkata to Chennai. But such a route has been eluding the western coastal plain since long. This is due to the structure and relief of the area. The outcrops of the Western Ghats are very close to the coast, especially near Goa and make the construction of railway lines a difficult task. However, the completion of Konkan Railway Line from Roha to Mangalore is a dream come true. It passes through several tunnels and over numerous bridges. This line has one of the longest tunnels in the country 6.5 km long, about 23 km south of Ratnagiri. It has become the life line of the western coastal plain. The total saving in travel distances are Mangalore-Mumbai (1,050 km), Mangalore-Ahmedabad (1,218 km), Mangalore-Delhi (707 km) and Kochi-Mumbai (437 km).

The above description leads us to the conclusion that railway services are unevenly distributed in India. The maximum concentration of railway network is found in the Indo-Gangetic plain followed by the peninsular plateau. The railways are practically absent from the Himalayan region. Such a lop-sided railway development has kept many areas away from the railway routes.

Railway Zones

At the time of Independence, there were as many as 42 different railway systems administered by 37 different companies. Immediately after the Independence, the Railway Board prepared a plan in 1950 for regrouping the Indian Railways into six zones, namely the Southern Zone (9,654 route km), Central Zone (8,689 route km), Western Zone (9,122 route km), North Zone (9,667 route km), North-Eastern Zone (7,726 route km) and Eastern Zone (9,109 route km). These zones were formed between 14 April 1951 and 14 April 1952. The Eastern railway was split into two zones *viz.*, Eastern Railway (3,735 route km) and South-Eastern Railway (5,374 route km). The North-Eastern Railway was also bifurcated on 15 January 1958 and new zones were inaugurated. They were North-east Frontier Railway (2,797 route km) and the North-Eastern Railway (4,929 route km). Another zone known as the South-Central Railway zone (6,072 route km) was carved out of Southern and Central railways on 2 Oct., 1966. These nine railway zones remained operative for about three decades and proved very effective in administrating the railway system. The administrative requirements of the railways became more pressing with the passage of time. Currently the railway network consists of 17 zones (**Table 26.2**).

TABLE 26.2. India : Railway Zones and their Headquarters

Zonal Railways	Headquarters
1. Central Railway	Mumbai CST
2. Eastern Railway	Kolkata
3. Northern Railway	New Delhi
4. North Eastern Railway	Gorakhpur
5. Northeast Frontier Railway	Maligaon (Guwahati)
6. Southern Railway	Chennai
7. South Central Railway	Secunderabad
8. South Eastern Railway	Kolkata
9. Western Railway	Church Gate, Mumbai
10. East Central Railway	Hajipur
11. East Coast Railway	Bhubaneshwar
12. North Central Railway	Allahabad
13. North Western Railway	Jaipur
14. South East Central Railway	Bilaspur
15. South Western Railway	Hubli
16. West Central Railway	Jabalpur
17. Metro Railway	Kolkata

Source : India 2014, A Reference Annual pp. 842-43.

1. Railway Gauges. 'Gauge' is the name given to the distance between the inner faces of the pair of rails in the track. Indian railways comprise three gauges *viz.*, broad gauge (1.675 metre), metre gauge (1.000 metre), and narrow gauge (0.762 metre and 0.610 metre). Different gauges had been the legacy of the British rulers. They constructed broad gauge railways on trunk routes connecting the port cities of Mumbai, Kolkata and Chennai and some other major cities. In areas lying beyond the frame work of trunk routes, only metre gauge lines were constructed. Thus, the area lying north of the Ghagra-Ganga alignment, whole of Rajasthan and Gujarat as well as large parts of the peninsular India were covered by metre gauge.

Different gauges create serious hinderance in the smooth flow of traffic. Passengers have to change trains at the *break of gauge* station and are put to great inconvenience. Goods have to be transhipped which results in loss of time, increased cost of transportation, pilferage and damage to consignments. The Government of India have, therefore, adopted a policy of gauge conversion, mainly from metre gauge to broad gauge. *The unigauge system of railways assures larger capacity, higher speed and cheaper transportation*. The process of gauge conversion was initiated immediately after Independence but significant achievement has been recorded in recent years (**Table 26.3**). Such a large scale gauge conversion is rightly called the *Operation Gauge Conversion or Operation Uni-Gauge*.

JAMMU-BARAMULA RAILWAY LINE

The Government of India has launched the most ambitious and at the same time most challenging programme to provide railway link connecting Baramula with Jammu-Tawi. When completed this 292 km long railway route will pass over 165 big and 650 small bridges. The bridge over the Chenab river is 1.3 km long and 359 metre tall which happens to be the tallest bridge in the world. Its 120.44 km stretch will pass through nearly 21 tunnels. The longest 11 km long tunnel is the PirPanjal tunnel which is the second largest tunnel of Asia after Wushaoling Tunnel (20 km) in Gansu, China. This tunnel has a maximum overburden (height of mountain strata above the tunnel) of 1,100 metres. This is 190 km away from Jammu and provides railway link between Qazigund in Kashmir valley and Jammu in the Jammu region. The work on the project started in 1984 most of the work has already been done and the work on the remaining portion is likely to be completed in due course of time. Work on the prestigious railway line is often hampered by unwanted law and order position, terrorism, sabotages, land acquisition, difficult terrain, landslides, etc. This railway line is expected to usher into a new era of economic growth and national integration by bring people of the Kashmir valley into the main stream of the country.

Track Electrification. It has been estimated that use of electric locomotives increases the capacity by as much as 100 per cent. But the use of electric locomotives is possible only if the railway tracks are electrified. Track electrification is a major thrust area by virtue of which efficiency of the railways can be increased considerably. Track electrification was introduced in early 1920s and the first two sections from Victoria Terminus to Kurla and from Victoria Terminus to Bandra, totalling 16 route km were electrified in 1925. Thus the Indian railways entered the push button era. In the first four decades from 1920-21 to 1960-61, the process of track electrification was rather slow and the length of electrified track stood at 388 km in 1950-51 and 748 km in 1960-61. After that the electrification of railway tracks picked up and the length of electrified track increased to 3,706 km in 1970-71, and 19,607 km in 2010-11. The percentage of electrified track was a meager 1.33 in 1960-61 which increased to 30.42 in 2010-11.

TABLE 26.3. Gaugewise Route Length of Railway in India

Year as on 31st March	Broad gauge		Metre gauge		Narrow gauge		Total
	Length in km	Percentage of total route length	Length in km	Percentage of total route length	Length in km	Percentage of total route length	
1992	35,109	56.21	23,283	37.28	4,066	6.51	62,458 (100)
2002	45,099	71.43	14,776	23.40	3,265	5.17	63,140 (100)
2012	55,956	88.62	6,347	9.82	2,297	3.56	64,600 (100)

Source : Data computed from Statistical Abstract, India, 2003, p. 213.

RAIL TRAFFIC

Rail traffic is broadly divided into two segments, *viz.*, passenger traffic, and (*ii*) goods traffic.

Passenger Traffic

Railway journey particularly long journey is preferred because it is cheaper and more convenient. The number of passengers has risen from 1,284 millions in 1950-51 to 8,420.7 millions in 2012-13. Passenger kilometres represent the real indices of the volume of passengers handled. These are arrived at by multiplying the total number of passengers carried by the respective number of kilometres over which they are moved. The passenger kilometres increased from 66.5 billion in 1950-51 to 1,098.1 billion in 2012-13. For passenger service five types of trains are run by the Indian Railways, based on their speed and comfort levels— Ordinary Passenger trains, Express/Mail trains, superfast trains, Rajdhani Express, and Shatabdi and Jan Shatabdi trains. Sampark Kranti Express trains have been introduced to connect the national capital, Delhi, with the state capitals and other important places. Further, Indian Railways have introduced computer reservation system making it possible to get instant reservation between any two stations from any booking office.

The above developments have resulted in phenomenal growth in passenger earning by railways. The passenger earnings increased from ₹ 98.2 crore in 1950-51 to ₹ 31,322.8 crore in 2012-13 (**Table 26.4**). On an average, 14 million people are moved by the Indian railways.

There are plans to introduce high speed trains on following routes.

1. Delhi-Agra.
2. Delhi-Chandigarh
3. Delhi-Kanpur
4. Nagpur-Bilaspur
5. Mysore-Bengaluru-Chennai
6. Mumbai-Goa
7. Mumbai-Ahmedabad
8. Chennai-Hyderabad
9. Nagpur-Secuderabad

Further, a bullet train has been planned between Mumbai and Ahmedabad.

The Railway Ministry has also drawn a blue print of **'Diamond Quadrilateral'** of high speed trains like the Golden Quadrilateral with reference to road transport. This diamond quadrilateral will provide high-speed trains service to important cities such as Amritsar, Delhi, Agra, Lucknow, Varanasi, Patna, Haora, Haldia, Jaipur, Ajmer, Ahmedabad, Mumbai, Thiruvananthapuram, Bengaluru, Chennai, Vijaywada, Hyderabad, etc.

Frieght Traffic

Along with passenger traffic, the freight traffic also increased tremendously. Development in industrial and agricultural sectors has generated high demand for rail transport. Major commodities transported by railways include coal, iron and steel, ores, petroleum products and such essential commodities as food grains, fertilizers, cement, sugar, salt, edible oils, etc. Consequently, freight traffic increased from 73.2 million tonnes in 1950-51 to 1008.1 million tonnes in 2012-13. Transport effort measured in terms of net tonnes kilometres increased from 37.6 billion in 1950-51 to 691.7 billion tonnes kilometres in 2012-13. Tonne kilometres are arrived at multiplying the total tonnage of goods carried by the number of kilometers over which they are moved.

Table 26.4 shows that railways earnings from goods carried is always higher than the passenger earnings. Earning from freight, traffic increased from ₹ 139.3 crore in 1950-51 to 84,378.8 in 2012-13.

Following measures have been taken to improve freight traffic by the Indian Railways :

(*i*) line capacity augmentation on certain critical sectors and modernization of signalling system.

(*ii*) improve in unit train operation for bulk commodities like coal.

(*iii*) increase in roller-bearing equipped wagons.

(*iv*) increase in tracking loads to 4,500 tonnes.

(*v*) operation uni-gauge on Indian Railways.

(*vi*) strengthening the track structure by providing heavier and stronger rails and concrete sleepers.

(*vii*) production of prototype electric locomotive of 5,600 HP for freight operation by Chittaranjan Locomotive Works.

TABLE-26.4. Operations of Indian Railways

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2009-10	2010-11	2011-12	2012-13
Originating traffic (million tonnes)	73.2	119.8	167.8	195.9	318.4	473.9	887.8	921.7	969.01	1,008.1
Goods carried (billion tonnes km.)	37.6	72.3	110.7	147.7	235.8	312.4	600.6	625.7	667.61	691.7
Passengers originating (million)	1,284.0	1,594.0	2,431.0	3,613.0	3,858.0	4,833.0	7,245.8	7,651.1	8,224.4	8,420.7
Passengers kilometres (billion)	66.5	77.7	118.1	208.6	295.6	457.0	903.0	978.5	1,046.5	1,098.1
Earnings from goods carried (₹ crore)	139.3	280.5	600.7	1,550.9	8,247.0	23,045.4	56,937.3	60,687.1	67,761.41	83,478.8
Passengers earnings (₹ crore)	98.2	131.6	295.5	827.5	31,44.7	10,575.1	23,488.2	25,792.6	28,296.9	31,322.8

Source : Economic Survey 2013-14, Statistical Appendix, p. 29.

Dedicated Freight Corridor Project

A very ambitious plan of Dedicated Freight Corridors (DFC) was initiated in the year 2009 which aims at improving the freight carrying capacity of the Indian Railways, reducing the unit cost of transportation and improving service quality. It consists of two corridors *viz.* Eastern Dedicated Freight Corridor (EDFC) and Western Dedicated Freight Corridor (WDFC). The EDFC is 1,839 route kilometres (RKM) and extends from Dankuni near Kolkata to Ludhiana in Punjab while the WDFC is 1,499 route kilometre (RKM) and extends from Jawahar Lal Nehru port in Mumbai to Dadri in Haryana. A special purpose vehicle, the Dedicated Freight Corridor Corporation of India Limited has been set-up to implement the project. Out of 10,703 hectares of land to be acquired for the project 7,768 hectares (73 per cent) has already been awarded under the Railway Amendment Act (RAA) 2008. Following are the salient features of this project.

- Only goods trains will be allowed to operate on these corridors. These trains will run at a speed of 100 kilometres per hour.
- These corridors are planned to run along the existing railway routes, but will provide services to railway junctions.
- With a view to keep minimum impact on social and environmental aspects, these corridors will have provision of bypasses for thickly populated big cities.
- Rail track on DFCs will strengthened by providing heavier and stronger rails on concrete sleepers.
- Transport cost will be reduced by increasing work efficiency.
- Efforts will be made to deliver the goods at their destinations well in time and minimise losses due to delayed deliveries of goods.
- Give impetus to industrial growth by providing cheap and efficient transport.
- Bring freight carrying capacity at par with world's best currently, long distance carrying capacity of Indian Railways is only 5,000 tonnes as against 20,000 tonnes in China and 35,000 tonnes in Australia.

Significance of the Indian Railways

1. Railways provide the cheapest and most convenient mode of passenger transport both for long distance and suburban traffic.

2. Railways have played a significant role in development and growth of industries. Growth of textile industry in Mumbai, jute industry in areas surrounding Kolkata, coal industry in Jharkhand, etc. is largely due to

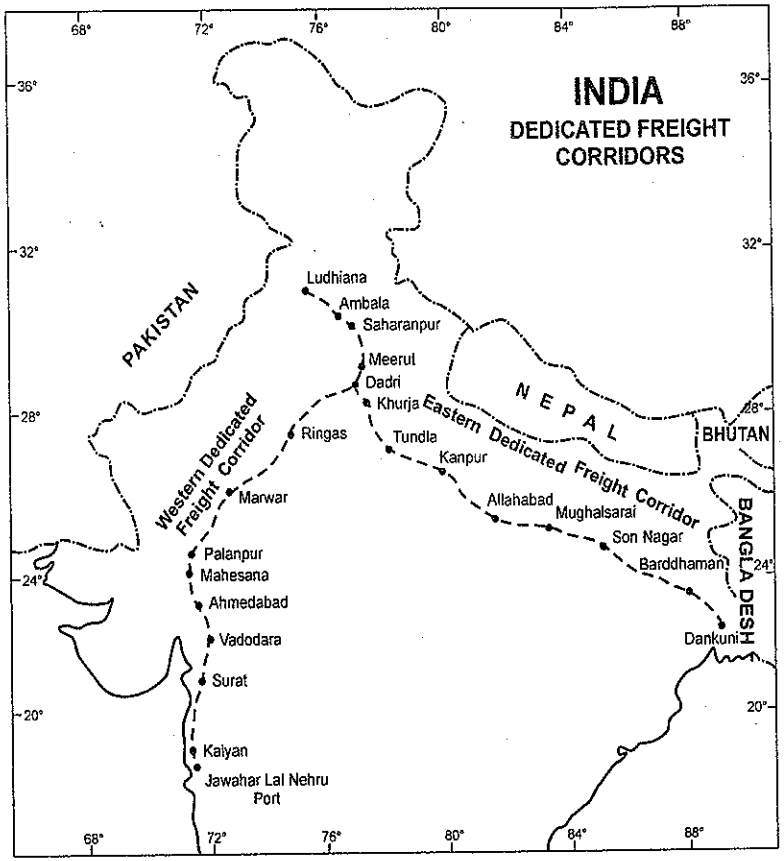

FIG. 26.2. Dedicated Freight Corridors.

the development of railway network in these areas. Railways help in supplying raw materials and other facilities to the factory sites and finished goods to the market.

3. Agriculture also owes its growth to railways to a great extent. Now farmers can sell their agricultural produce to distant places and even sell them in the world market at remunerative prices.
4. Railways are also helpful in removing isolation between cities and countryside and have played a significant role in disseminating innovations and new ideas.
5. Railways are particularly suited to long distance journey and provide a strong medium of national integration.
6. Railways play a vital role in mitigating the sufferings of the people in the event of natural calamities like droughts, floods, famines, earthquakes, etc. This is done by carrying relief and rescue teams and essential items to the affected areas and save people from sufferings and starvation.
7. Railways also help in facing man-made calamities like social, political, religious disturbances, insurgency, etc. It facilitates easy movement of police, troops, defence equipment, etc. The importance of railways to save the country's freedom and integrity from external aggression has been proved at several occasions.
8. Railways carry the British legacy and connect major ports to their hinterlands, thereby lending a helping hand to the overall prosperity of the coastal areas.
9. Introduction of superfast trains and container services in major cities of India have ensured quick movement of men and material.
10. Railways are specially suited to long haulage of bulky materials like coal, petroleum and ores.

Problems of Indian Railways

Although Indian Railways have progressed a lot, both quantitatively and qualitatively, during the last few years, this system is still plagued by a number of problems which require immediate attention. A lot has been done, but a lot more is yet to be done. Some of the major problems faced by the Indian Railways are briefly discussed as under :

1. Safety. Indian Railways have been in the news albeit for wrong reasons. With the rapid increase in passenger and goods traffic, the frequency of train accidents is increasing very fast. This has raised serious doubts in the public mind about safety of rail travel and the general health of the railway network. The credibility of an organisation with a long and proud history of nation building has been seriously eroded. On an average the Railways report 20 major collisions, 350 derailments and around 80 level crossing accidents in a year. Approximately 3000 passengers have lost their lives in ten years from 2003 to 2013.

There are several factors which are responsible for increasing number of railway accidents; some outstanding being overaged tracks, wagons, coaches, bridges and signaling system. According to the Khanna Railways Safety Review Committee Report, nearly 25 per cent of the total railway track in India is overaged and is due for replacement. The tracks suffer from fatigue and wear and tear in due course of time, and their replacement should be carried on side by side. In several derailments poor condition of tracks had been found responsible. The condition of tracks becomes more significant when one looks at the other assets of the Railways. The Khanna Railways Safety Committee had reported that Indian Railways have 34,000 overaged wagons, 1,322 overaged coaches, and 1,560 stations with overaged signalling. Moreover, 262 bridges are listed "distressed." The white paper released by the Railway in April, 2003 acknowledges that over 51,000 bridges are of 19th century vintage. Out of a total of 1,27,154 bridges in India, 56,178 are more than 80 years old. Thus 44.17 per cent of the bridges have outlived their life. According to the review conducted by the Comptroller General of India on various aspects of bridge management between 1997-98 to 2001-02, these old bridges include 339 important, 4,210 major and 51,629 minor bridges built before 1920. The Khanna Committee had further reported that 76 per cent of all rail accidents are due to derailments, 7 per cent due to collisions, 16 per cent take place at level crossings and 1 per cent are due to fires. Resource crunch is said to be the main cause of all these happenings in the Indian Railways.

Worried about the increasing rate of accidents and loss of life and property resulting from these accidents, the Indian Railways have come out with Anti-collision Devices (ACDs) or '*Raksha Kavach*' to get rid of such happenings. World's first Networked Anti-collision Devices (ACDs) *Raksha Kavach*, invented by Konkan Railway is a microprocessor system comprising of a central processing unit, a Global Position System (GPS) Receiver and a digital radio modem for communication between ACDs. When fitted to a guard van it becomes a Guard ACD. When fitted at stations it becomes a Station ACD and when fitted at level crossing gates, it becomes a Gate ACD. They all network among themselves, exchange information and take decision to prevent collision type of dangerous situations well in time automatically, without mannual inputs, forming *Raksha Kavach* against collisions.

Extensive field tests of *Raksha Kavach* have been conducted successfully on Indian Railways. Survey for implementation of ACDs has already been completed for 3,300 route km on Indian Railways and 760 km on Konkan Railway. About 1,770 ACDs on 1,736 km route length of North East Frontier Railways covering 183 stations have been installed at the cost of ₹ 50 crore.

Modern signalling like panel inter-locking, route relay inter-locking, centralised traffic control, automatic signalling and multi-aspect colour light signalling, are being progressively introduced.

2. Cost and Revenue Problems. As is the case with most of the government organisations, Indian Railways face chronic financial crisis. The annual rate of increase in cost has overtaken that of revenues during the last few years. A study of Railways finances from 1998 to 2004 revealed that the revenues increased at an average annual rate of 8.7 per cent against the 9.65 per cent average annual growth in costs. While the Indian Railways' input costs increased by 10.6 per cent per annum between 2004-05 and 2010-11, passenger fairs remained unchanged or were even reduced in lower classes thereby constraining internal resource generation, essential for replacement/renewal of assets, operation and maintenance activities and critical safety and amenity works. In certain years, the revenue growth rate does exceed that of cost. But this position is achieved by providing inadequacy for replacements and severely controlling the costs. Such a situation has long term implications as it affects the internal generation of resources. Following are the main causes of costs and revenue problems. In 2013-14, half of the 17 railway zones reported an operating ratio (rupee spent against every rupee earned) of more than 100 per cent which means that the railways are spending either equal or more than the money earned.

(i) Low level of employee productivity. Indian Railways face a serious problem of low level of employee productivity. Transport output in terms of passengers and freight tonne kilometres per employee on Indian Railways is only 400 as compared to 500 for Chinese and 570 for French Railways. An estimated 30 per cent surplus workforce and operation of a number of lines with low traffic and assets not essential for the Railways are contributory factors.

(ii) Staff Wages. With the implementation of the recommendations of the Sixth Pay Commission, staff wages have increased tremendously and have put heavy strain on the financial resources of the Railways. With life expectancy going up and wage escalations taking place periodically, the position will only worsen leaving little scope for development plans. The recommendation of the Seventh Pay Commission will put further heavy burden on the financial resources of the railways.

(iii) Increase in lease charges. Paucity of funds forces the Indian Railways to resort to market borrowings which results in increased lease charges. Market borrowings started in 1986 and the trend is increasing. At present payout of lease charges constitute about 8.5 per cent of the revenue.

3. Slowdown in Revenue Growth. With saturation of trunk routes and low quality of services and reliability, the revenue growth has registered a slowdown. The railways are increasingly becoming a transporter of bulk commodities for public sector (coal, iron ore, foodgrains, etc.) and are consistently loosing to roadways. Most of the national highways run parallel to railways and are consistently snatching revenues from the railways.

4. Social Burden. Indian Railways have to play a dual role of revenue earning as well as meeting the social obligations. The Expert Group, constituted in December 1998 to study the railway sector, termed it as the 'split personality'. On one hand, the Railways are seen as a commercial organisation and on the other hand, it is treated as a social organisation which must fulfil its social obligations. The two functions are diametrically opposite and difficult to reconcile. There are several social obligations on the railways which are always running below cost. Suburban passenger services, concessionary travel to certain section of travellers, concessional freight movement of certain commodities, particularly to remote and inaccessible areas like the North-east region, providing rail services to backward regions are some of the outstanding social obligations on the Indian Railways.

5. Other Problems. A large number of miscellaneous problems include late running of trains, lack of passenger facilities including cleanliness at the railway stations, lack of security arrangement on the railways resulting in thefts and dacoities, etc. Political pressure and interference is a very big problem which the Indian Railways are facing with increasing impact. Several projects which are not economically viable have been initiated for political considerations.

METRO RAIL

Mero rail offers fast, cheap and comfortable journey in metropolitan cities of India. It helps in reducing pressure on the existing road transport and provides clean and eco-friendly transport at the local level. With the introduction of metro rail in the big cities, traffic jams on road crossings have reduced considerably. It is a part of rapid mass transport and is of recent origin in India. The first rapid transit system in India was the Kolkata Metro, which started operations in 1984. The Delhi Metro was India's first modern metro and third rapid transit system in India, after the Kolkata Metro and Chennai Mass Rapid Transit System. The Delhi Metro Rail started its operations in 2002 and is now providing transport facilities to most parts of the capital city. It also provides metro rail lines to most of the satellite towns

TABLE 26.5. Metro Rail in India

City	System	Start Operation	System length in km		
			In operation	Planned	Under construction
1. Kolkata	Kolkata Metro	24 October, 1984	28.4	—	90
2. Chennai	Chennai MRTS	1 November, 1995	19.34	—	—
3. Delhi	Delhi Metro	24 December, 2012	192.27	—	—
4. Bengaluru	Mamma Metro	20 October, 2011	16.6	114.39	42.3
5. Gurgaon	Rapid Metro Rail, Gurgaon	14 November, 2013	5.1	—	—
6. Jaipur	Jaipur Metro	2014	—	32.5	—
7. Chennai	Chennai Metro	20.14	45.1	—	—
8. Mumbai	Mumbai Metro	2014	146.5	—	—
9. Navi Mumbai	Navi Mumbai Metro	2016	106.4	—	—
10. Kochi	Kochi Metro	2016	25.6	—	—
11. Lucknow	Lucknow Metro	2017	36	—	—
12. Hyderabad	Hyderabad Metro	2015	71.6	—	—
13. Ahmedabad and Gandhinagar	Metrolink Express Gandhinagar and Ahmedabad (MEGA)	2017	83	—	—
14. Bhopal	Bhopal Metro	—	—	—	—
15. Chandigarh	Chandigarh Metro	2018	37.5	—	—
16. Indore	Indore Metro	2020	30	—	—
17. Kanpur	Kanpur Metro	2018	84	—	—
18. Ludhiana	Ludhiana Metro	2017-18	—	—	—
19. Nagpur	Nagpur Metro	—	39.8	—	—
20. Nashik	Greater Nashik Metro	—	—	—	—
21. Patna	Patna Metro	2016	60	—	—
22. Pune	Pune Metro	2018	82	—	—
23. Surat	Surat Metro	2018	—	—	—
24. Mumbai	Western Railway Elevated Corridor	2020	63.27	—	—
25. Guwahati	—	—	44.2	—	—
26. National Capital Region	National Capital Region Metro	2021	381	—	—

Source : en.wikipedia.org/wiki/rapid_transit-in-India.

like Gurgaon, NOIDA, Faridabad, Bahadurgarh, etc. Rapid Metro Rail Gurgaon is India's first privately owned and operated metro rail system. In started its operations in November, 2013. After the grand success of Delhi Metro Rail, other cities like Bengaluru, Hyderabad, Lucknow, Kanpur, Ludhiana, and many more are planning to have metro rails and in many cities this rail system is already in operation. The Government has planned to provide metro rail facilities in all cities of India having a population over two billion. **Table 26.5** gives details of metro rail system in different cities of India.

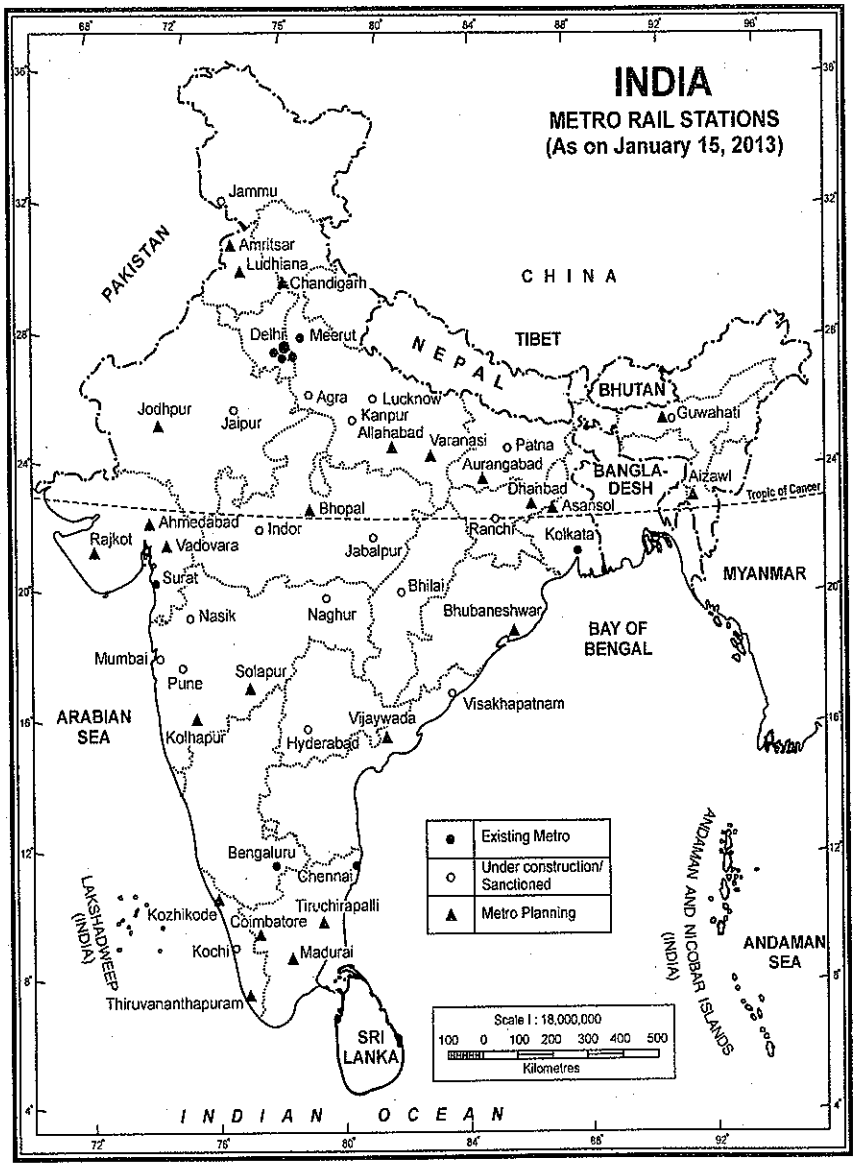

FIG. 26.3. Metro Rail Status (as on January 15, 2013)

ROADWAYS

Roads have been existing in India for the last 5000 years. In early stages of Indian history, Ashoka and Chandragupta made efforts to construct roads. But the real progress was made during the Mughal period. A number of roads were laid during the Sultanate and Mughal periods. Most of the present trunk routes follow the Mughal routes. These routes were essential for strengthening and consolidating the empire. One such road was constructed by Sher Shah Suri which connected Peshawar to Kolkata. It was named as Grand Trunk (G.T.) Road and joined Amritsar with Kolkata after partition of India in 1947. Presently, it is known as 'Sher Shah Suri Marg'.

Importance of Roads

1. Roads play a very important role in the transportation of goods and passengers for short and medium distances.
2. It is comparatively easy and cheap to construct and maintain roads.
3. Road transport system establishes easy contact between farms, fields, factories and markets and provides door to door service.
4. Roads can negotiate high gradients and sharp turns which railways cannot do. As such, roads can be constructed in hilly areas also.
5. Roads act as great feeders to railways. Without good and sufficient roads, railways cannot collect sufficient produce to make their operation possible.
6. Road transport is more flexible than the railway transport. Buses and trucks may be stopped anywhere and at any time on the road for loading and unloading passengers and goods whereas trains stop only at particular stations.
7. Perishable commodities like vegetables, fruits and milk are transported more easily and quickly by roads than by railways.

Due to above-mentioned advantages, the road transport has become very popular and its share in traffic is constantly increasing.

Growth and Development

Road transport in modern sense *i.e.* vehicles driven by internal combusion engines using petrol or diesel as fuel was practically negligible in India before World War II. Following plans have been drawn to develop roadways in India.

1. **Nagpur Plan.** First serious attempt to develop roadways was made in 1943 when ***Nagpur Plan*** was drawn. This plan envisaged increasing of the kilometreage of major roads to 1,96,800 km and of other roads to 3,32,800 km by 1953. The highlight of the plan was that no village in a developed agricultural region should be more than 8 km from a major road or 3 km away from any other road while the average distance of villages from a major road should be less than 3.2 km. In a non-agricultural region, these distances were fixed at 32, 8 and 10 km respectively. This plan could not be implemented immediately because the country was ruled by a number of princely states outside British India. The concerted efforts to achieve the objectives of this plan were made only after the reorganisation of the states. The targets of this plan were more or less achieved by 1961.

2. Twenty Year Plan. After achieving the objectives of the Nagpur Plan, another plan known as ***Twenty Year Road Plan*** was drawn in 1961. It aimed at increasing the road length from 6.56 lakh km to 10.60 lakh km and the density to 32 km of road per 100 sq km by 1981. The other objectives of the Twenty Year Road Plan were (*i*) to bring every village in a developed agricultural area within 6.4 km of a metalled road and 2.4 km of any other road, (*ii*) to bring every village in a semi-developed area within 12.8 km of a metalled road and (*iii*) to bring every village in an undeveloped and uncultivated area within 19.2 km of a metalled road and 8 km of any other road.

3. The Rural Development Plan includes construction of rural roads under Minimum Needs Programme (MNP), Rural Landless Employment Guarantee Programme (RLEGP), Jawahar Rojgar Yojana (JRY) and Command Area Development (CAD) programmes to connect all villages having a population of 1,500 or more with all weather roads and those having less than 1,500 population with link roads.

4. Build Operate Transfer (BOT) is a scheme under which private operators are invited to construct roads and bridges. They are allowed to collect toll tax

from the vehicles using these roads and bridges for a specific period of time after which these assets are transferred to the government. The National Highways Act has been amended to facilitate private investment in real construction under BOT scheme.

5. Central Road Fund (CRF) is being raised for the betterment of roads by imposing additional excise/customs duty at the rate of ₹ 1.50 per litre on petrol with effect from 2 June 1998 and on High Speed Diesel (HSD) with effect from February 28, 1999. The annual accrual through this source was to be about ₹ 5,500 crore. A part of this (₹ 0.4 per litre against sale of high speed diesel oil and ₹ 0.86 per litre against sale of petrol) goes to fund the NHDP. (National Highway Development Projects).

The Central Road Fund Act 2000 was enacted in December, 2000 with the primary objective of providing regular and adequate flow of funds for development of the road sector. This is a non-lapsable fund. The Act empowers the Centre to administer, manage and allocate the accrued amount to the following :

(*i*) Development of rural roads. About 43 per cent of the levy on diesel is to be spent on improving road connectivity,

(*ii*) Development and maintenance of National Highways,

(*iii*) Construction of road under/over bridges and safety works at unmanned railway crossings, and

(*iv*) Development and maintenance of State roads.

Categorywise Growth in Road Length. Table 26.6 shows that the length of National Highways rose from 19,811 kilometres as on 31 March 1951 to 70,934 kilometres as on 31 March 2011 and to 79,116 kilometres as on 31st March, 2013 reflecting a compound annual growth rate (CAGR) of 2.1 per cent during the period. During the same period, the combined network of State Highways and Other Public Works Department (PWD) posted a seven-fold expansion in length. The combined length of State Highways and Other PWD roads stood at 11.69 lakh kilometres as on 31 March 2011. The highest CAGR of 4.4 per cent during 1951 to 2011 was registered by rural roads comprising Panchayati roads, and roads constructed under Jawahar Rozgar Yojana (JRY) and Pradhan Mantri Gram Sadak Yojana (PMGSY). The length of rural roads increased more than 13 times from 2.06 lakh kilometres in 1951 to 27.50 lakh kilometres in 2011. Urban roads grew by a CAGR of 4.5 per cent between 1961 and 2011. Their length stood at 4.12 lakh kilometres as on 31 March 2011. The length of Project roads grew by CAGR of 2 per cent during 1971 and 2011 and was 2.88 lakh kilometres as on 31 March 2011.

TABLE 26.6. Road Network by Categories (in kilometres) 1951 to 2011

Road Category	1951	1961	1971	1981	1991	2001	2011
1	2	3	4	5	6	7	8
National Highways	19,811 (4.95)	23,798 (4.54)	23,838 (2.61)	31,671 (2.13)	33,650 (1.45)	57,737 (1.71)	70,934* (1.51)
State Highways	1,73,723 (43.44)	257,125 (49.02)	56,765 (6.20)	94.359 (6.35)	1,27,311 (5.47)	1,32,100 (3.99)	1,63,898 (3.49)
Other PWD Roads	^	^	2,76,833 (30.26)	4,21,895 (28.40)	5,09,435 (21.89)	7,36,001 (21.82)	10,05,327 (21.43)
Rural Road	2,06,408 (51.61)	1,97,194 (37.60)	3,54,530 (38.75)	6,28,865 (42.34)	12,60,430 (54.16)	19,72,016 (58.46)	27,49,805 (58.63)
Urban Road	0 (0.00)	46.361 (8.84)	72.120 (7.88)	1,23,120 (8.29)	1,86,799 (8.03)	2,52,001 (7.12)	4,11,840 (8.78)
Project Roads	0 (0.00)	0 (0.00)	1,30,893 (14.31)	1,85,511 (12.49)	2,09,737 (9.01)	2,23,665 (6.32)	2,.88,539 (6.15)
Total	**3,99,942**	**5,24,478**	**9,14,979**	**14,85,421**	**23,27,362**	**33,73,520**	**46,90,342**

Note : Figures within parentheses indicate per cent to total road length in each road category.

*79,116 kilometres as on 31st March, 2013.

^ Included in State Highways

Source : Statistical Year Book, India 2013, p. 301.

Classification of Roads

The main significance of the Nagpur Plan lies in the fact that it classified roads into four categories on the functional basis. They are : (*i*) National Highways (*ii*) State Highways (*iii*) District Roads and (*iv*) Village Roads. A brief description of each category is given as under :

1. National Highways

The main roads which are constructed and maintained by the Central Public Works Department (CPWD) are known as the National Highways. These roads are meant for inter-state and strategic defence movements and connect the state capitals, big cities, important ports, big railway junctions and link up with border roads. The length of National Highways increased from 19,811 km in 1951 79,116 km in 2013. National Highways form the lifeline of road transport and constitute the framework of road system in India. Although the percentage share of the National Highways to the total road length has decreased considerably from 4.95 per cent in 1951 to only 1.7 per cent in 2013, they carry nearly 40 per cent of the road traffic of India.

The National Highways have been classified on the basis of carriage way width of the highway. Generally, a lane has a width of 3.75 m in case of single lane and 3.5 m per lane in case of multi-lane. National Highways. The percentage of National Highways in terms of width is as under :

Single Lane	19,330 km (24%)
Double Lane	40,658 km (52%)
Four Lane/Six Lane/Eight Lane	19,128 km (24%)

Source : India 2014, A Reference Annual, p. 845.

The Government has embarked upon a massive National Highways Development Project (NHDP) in the country. The NHDP is the largest highway project ever undertaken in the country. The NHDP is being implemented mainly by NHAI in phases I to VII.

- **NHDP Phase I & II:** Envisage 4/6 laning of about 14,000 km of National Highways, at an estimated cost of about ₹ 65,000 crore at 2004 prices. These two phases comprise Golden Quadrilateral (GQ), North-South and East-West corridor (NSEW), Port Connectivity and Other Projects. The GQ consists of 5,846 km and connects four major cities, *viz*., Delhi, Mumbai, Chennai and Kolkata. The NSEW corridor comprising a length of 7,142 km connects Srinagar in the North to Kanniyakumari in the South including a spur from Salem to Kochi and Silchar in the East to Porbandar in the West, respectively. The NHDP also includes Port Connectivity Project comprising a length of 380 km for improvement of roads connecting 12 major ports in the country alongwith other projects involving a length of 965 km are also included.
- **NHDP Phase III:** NHDP Phase-II involves 4-laning of 12,109 km of NHS having high density corridor connecting State capitals, important tourist places, economically important areas, etc. on PPP basis at an estimated cost of ₹ 80,628 crore.
- **NHDP Phase IV:** It involves upgradation/ strengthening of 20,000 km of single/ intermediate /two lane National Highways to two lanes with paved shoulders on BOT (Toll) and BOT (Annuity) basis.
- **NHDP Phase V:** It involves six laning of 6,500 km of NHs comprising 5,700 km of GQ and balance 800 km of other sections of NHs at a cost of ₹ 41,210 crore.
- **NHDP Phase VI:** It involves construction of 1,000 km of expressways with hill access control on new alignments at a cost of ₹ 16,680 crore.
- **NHDP Phase VII:** It involves construction of 700 km of ring roads of major towns and bypasses and construction of other stand-alone structures such as flyovers, elevated roads, tunnels, undespasses, grade separated interchanges etc. on National Highways at a cost of ₹ 16,680 crore.

SpecialW Accelerated Road Development Programme for North Eastern region (SARDP-NE). It envisages improvement of road connectivity to the State Capitals with District Headquarters in the North Eastern region. The proposed programme includes improvement of 10,141 km of roads comprising National Highways (4,798 km) and state roads (5,343 km), to be implemented under Phase-A, Phase 'B' and Arunachal Pradesh Package for 'Road & Highways. Phase-A now consists improvement of 2,041 km of National Highways and 2,058 km of State Roads. Phase-B has now been modified to cover 2 laning of 1,285 km of NHs and 2 laning/ improvement of 2,438 km of State roads for preparation of Detailed Project Reports (DPRs). Arunachal Pradesh Package of roads and highways comprises 1,472 km of National Highways and 847 km of State Roads.

Development of Roads in Left Wing Extremism affected areas

The Government of India, approved the Road Requirement Plan (RRP) on 26 February, 2009 for upgrading 5,565 km long roads out of which 1,202 km are the national highways and 4,363 km are state roads. The upgradation is with respect to two-lane provision in 34 core districts affected by left-wing extremism (LWE). These districts are in the states of Andhra Pradesh, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and Uttar Pradesh. The project is expected to cost ₹ 7,300 crores. Development of 2,929 km length had been completed till 2013-14 and the rest is likely to be completed by March 2015. RRP-E covering a length of 5,624 km at an estimated cost of ₹ 9,900 crore is under consideration of the government.

1. Golden Quadrilateral Super Highway. National Highways Development Project (NHDP) has taken up a massive programme of road building in the country. Launched on January 2, 1999, this is perhaps one of the largest programmes of road development ever taken up in the country. The project is being implemented by National Highways Authority of India (NHAI). NHDP has following two components.

(i) Phase I—Golden Quaderilateral. Comprising National Highways connecting Delhi-Mumbai-Chennai-Kolkata-Delhi by six-lane super highways. This component has a total length of 5,846 km. The four sides of the quadrilateral have varying length. The side of quadrilateral between Delhi and Mumbai is 1,419 km long, Mumbai to Chennai is 1,290 km long, Chennai to Kolkata is the longest side which is 1,684 km long. The side between Kolkata and Delhi is 1,453 km long.

TABLE 26.7. Overall Progress of NHDP as on 31st May, 2011

Phases	Total (km)	4/6 laned (km)	km	Contracts (No)	Balance for award
GO (Golden Quadrilateral)	5,846	5,827 (99.67%)	19	8	—
NS & EW corridors	7,142	5,733.	988	87	421
Port Conductivity	380	318	62	4	0
Other NHs	1,383	936	427	6	20
SARDP-NE	388	—	112	2	276
NHDP Phase					
III	12,109	2,351	5,925	82	3,833
IV	20,000	—	873	6	19,127
V	6,500	619	2,018	19	3,863
VII	700	—	41	2	659
Total	**54,448**	**15,784**	**10,465**	**216**	**28,199**

(ii) Phase II—North-South Corridor. Comprising the National Highways connecting Srinagar to Kanniyakumari including Kochi-Salem Spur and *East-West corridor* comprising the National Highways connecting Silchar in Assam and Porbandar in Gujarat. The project has a total length of about 7,300 km, out of which the North-South corridor is 4,000 km and East-West corridor is 3,300 km long.

Main components of the Golden Quadrilateral are shown in **Fig. 26.4**.

Distribution of National Highways. A number of national highways run across the country in all directions linking important places to one another. The historically important Sher Shah Suri Marg is known as National Highway 1. It links Delhi and Amritsar. National Highway 2 links Delhi and Kolkata. National Highway 3 runs between Agra and Mumbai via Gwalior, Indore and Nasik. National Highway 7 is the longest one which links Varanasi with Kanniyakumari via Jabalpur, Nagpur, Hyderabad, Bangalore and Madurai. It traverses a distance of 2,325 km. National Highway 5 and 17 run along the eastern and western coasts respectively. National Highway 15 represents the border road in Rajasthan desert and runs through Kandla, Jaisalmer, Bikaner and joins the border road in the Punjab. **Fig. 26.5** shows the important national highways.

TABLE 26.8. Length of Various Sections of the Golden Quadrilateral

Name	Length of sides of the Golden Quadrilateral (Length in km)
Delhi-Mumbai	1,419
Mumbai-Chennai	1,290
Chennai-Kolkata	1,684
Kolkata-Delhi	1,453
Total	**5,846**
	Length of Corridors
North-South corridor Connecting Srinagar with Kanniyakumari	4,000
East-West corridor connecting Silchar with Porbandar	3,300
Total	**7,300**

Some of the important National Highways are listed in **Table 26.9**

TABLE 26.9. India : Some Important National Highways

No.	Route	Length (km)
1.	Delhi-Ambala-Jalandhar-Amritsar	456
1A.	Jalandhar-Madhopur-Jammu-Srinagar-Baramula-Uri	663
1B.	Batot-Doda-Kishtwar	107
2.	Delhi-Mathura-Agra-Kanpur-Allahabad-Varanasi-Mohania-Barhi-Kolkata	1,490
3.	Agra-Gwalior-Shivpuri-Indore-Dhulia-Nashik-Thane-Mumbai	1,161
4.	Thane-Pune-Belgaum-Hubli-Bengaluru-Ranipet-Chennai	1,235
4A.	Belgaum-Anmode-Ponda-Panaji	153
5.	Bahargagora-Cuttack-Bhubaneshwar-Vishakhapatanam-Vijyawada-Chennai	1,533
6.	Dhule-Nagpur-Raipur-Sambalpur-Baharagora-Kolkata	1,645
7.	Varanasi-Rewa-Jabalpur-Nagpur-Hyderabad-Bangalore-Madurai-Kanniyakumari	2,369
8.	Delhi-Jaipur-Ajmer-Udaipur-Ahmadabad-Vadodara-Mumbai	1,428
9.	Pune-Solapur-Hyderabad-Vijayawada	791
10.	Delhi-Fazilka	403
11.	Agra-Bharatpur-Jaipur-Bikaner	582
12.	Jabalpur-Bhopal-Kota-Bundi-Japiur	890
13.	Solapur-Chitradurga	491
14.	Beawar-Sirohi-Radhanpur	450

15.	Pathankot-Bathinda-Bikaner-Jaisalmer	1,526
16.	Barmer-Samkhiyali-Jagdalpur	460
17.	Panvel-Mangalore-Edapalli	1,269
18.	Kurnool-Nandyal-Cuddapah-Chittoor	369
20.	Pathankot-Mandi	220
21.	Chandigarh-Ropar-Mandi-Kulu-Manali	323
22.	Ambala-Kalka-Shimla-Narkanda-Rampur-Chini	462
23.	Chas-Ranchi-Rourkela-Talwar	459
24.	Delhi-Bareilly-Lucknow	438
25.	Lucknow-Kanpur-Jhansi-Shivpuri	319
26.	Jhansi-Lakhnaden	396
27.	Allahabad-Mangawan	93
28.	Barauni-Muzaffarpur-Gorakhpur-Lucknow	570
28A.	Pipra-Sagauli-Razaul	68
29	Gorakhpur-Ghazipur-Varanasi	198
30.	Mohania-Patna-Bakhtiyarpur	230
31.	Bakhtiyarpur-Siliguri-Nalbari-Aminagaon	1,125
31A.	Sivok-Gangtok	92
32.	Govindpur-Dhanbad-Jamshedpur	179
33.	Barhi-Ranchi	352
34.	Dalkhola-Barasat-Kolkata	443
35.	Barasat-Bangaon	61
36.	Nagaon-Dabaka-Dimapur	170
37.	Goalpara-Guwahati-Kamargaon-Saikhoa Ghat	680
38.	Makum-Ledo-Lekhapani	54
39.	Numiligarh-Imphal-Palel	436
40.	Jorhat-Shillong-Dawki	161
41.	Kolaghat-Haldia	51
42.	Sambalpur-Angul-Cuttack	261
43.	Raipur-Vizianagaram	560
44.	Shillong-Passi-Badarpur-Agartala	495
45.	Chennai-Tiruchchirappalli-Dindigul	387
46.	Krishnagiri-Ranipet	132
47.	Salem-Coimbatore-Thiruvananthapuram-Kanniyakumari	640
48.	Bangalore-Hassan-Mangalore	328
49.	Kochi-Madurai-Dhanushknodi	440
50.	Nashik-Pune	192
51.	Pekana-Tura-Dalu	149
52.	Baihata-Charali-Tezpur-Lakhimpur-Sekhoaghat	850
53.	Badarpur-Zirighat-Imphal-Silchar	320
54.	Silchar-Aizawl	560
55.	Siliguri-Darjeeling	77
56.	Lucknow-Varanasi	285

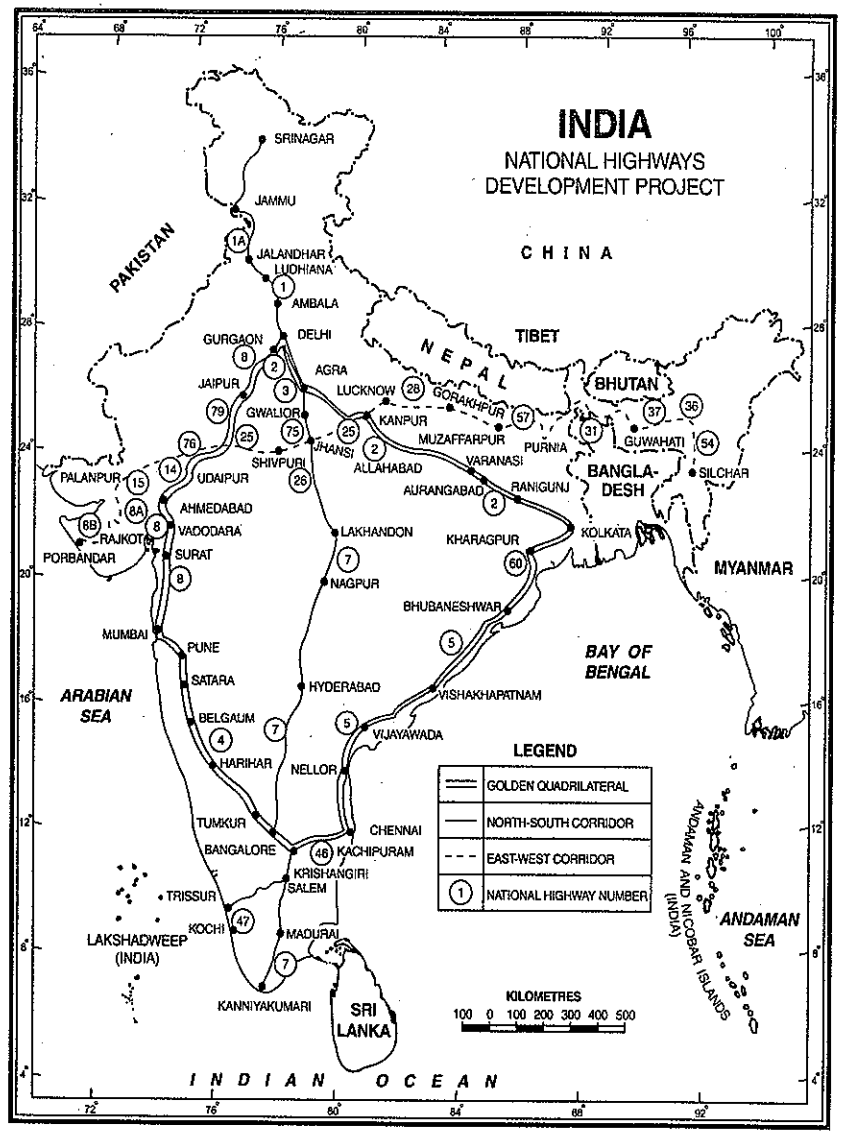

FIG. 26.4. India : National Highways Development Project.

Table 26.10 depicts the state-wise distribution of National Highways. This table shows that Uttar Pradesh has the longest length of National Highway covering a distance of 5,874 km. This is followed by Rajasthan (5,585 km), Madhya Pradesh (4,670 km), Andhra Pradesh and Telangana (4,472 km) and Tamil Nadu (4,462 km).

The Government of India declared the following new National Highways in August, 2014.

NEWLY DECLARED NATIONAL HIGHWAYS

- **NH-11** Narnaul—Rewari
- **NH-54** Dabwali—Hanumangarh—Goluwala
- **NH-248A** Nuh—Gurgaon
- **NH-344B** Sonepat—Jhajjar—Joharu
- **NH-703** Sirsa—Haryana/Punjab border

TABLE 26.10. List of State-wise National Highways in India

Sl. No.	Name of State	National Highway No.	Total Length (in km)
1	Andhra Pradesh (including Telangana)	4, 5, 7, 9, 16, 18, 43, 63, 202, 205, 214, 214A, 219, 221 & 222	4,472
2	Arunachal Pradesh	52, 52A & 153	392
3	Assam	31, 31B, 31C, 36, 37, 37A, 38, 39, 44, 51, 52, 52A. 52B, 53, 54, 61, 62, 151, 152, 153 &154	2,836
4	Bihar	2, 2C, 19, 28, 28A, 28B, 30, 30A, 31, 57, 57A, 77, 80, 81, 82, 83, 84, 85, 98, 99, 101, 102, 103, 104, 105, 106, 107 & 110	3,642
5	Chandigarh	21	24
6	Chhattisgarh	6, 12A, 16, 43, 78, 111, 200, 202, 211, 216 and 217	2,184
7	Delhi	1, 2, 8, 10 & 24	72
8	Goa	4A, 17, 17A & 17B	269
9	Gujarat	NE-I, 6, 8, 8A, 8B, 8C, 8D, 8E, 14, 15, 59, 113 & 228	3,245
10	Haryana	1, 2, 8, 10, 21A, 22, 64, 65, 71, 71A, 71B, 72, 73, 73A , & NE-II	1,512
11	Himachal Pradesh	1A, 20, 21, 21A, 22, 70, 72, 73A & 88	1,208
12	Jammu & Kashmir	1A, 1B, 1C &1D	1,245
13	Jharkhand	2, 6, 23, 31, 32, 33, 75, 78, 80, 98, 99 & 100	1,805
14	Karnataka	4, 4A, 7, 9, 13, 17, 48, 63, 67, 206, 207, 209, 212 & 218	3,843
15	Kerala	17, 47, 47A, 47C, 49, 208, 212, 213, & 220	1,457
16	Madhya Pradesh	3, 7, 12, 12A, 25, 26, 26A, 27, 59, 59A, 69, 75, 76, 78, 86 & 92	4,670
17	Maharashtra	3, 4, 4B, 4C, 6, 7, 8, 9, 13, 16, 17, 50, 69, 204, 211 & 222	4,176
18	Manipur	39, 53.150 & 155	959
19	Meghalaya	40, 44, 51 & 62	810
20	Mizoram	44A, 54, 54A, 54B, 150 & 154	927
21	Nagaland	36, 39, 61, 150 & 155	494
22	Odisha	5, 5A, 6, 23, 42, 43, 60, 75, 200, 201, 203, 203A, 215, 217 & 224	3,704
23	Puducherry	45A & 66	53
24	Punjab	1, 1A, 10, 15, 20, 21, 22, 64, 70, 71, 72 & 95	1,557
25	Rajasthan	3, 8, 11, 11A, 11B, 11C, 12, 14, 15, 65, 71B, 76, 79, 79A, 89, 90, 112, 113, 114 & 116	5,585
26	Sikkim	31A	62
27	Tamilnadu	4, 5, 7, 7A, 45, 45A, 45B, 45C, 46, 47, 47B, 49, 66, 67, 68, 205, 207, 208, 209, 210, 219, 220, 226 & 227	4,462
28	Tripura	44 & 44A	400
29	Uttar Pradesh	2, 2A, 3, 7, 11, 12A, 19, 24, 24A, 24B, 25, 25A, 26. 27, 28, 28B, 28C, 29, 56, 56A, 56B, 58, 72A, 73, 74, 75, 76, 86, 87, 91, 91A, 92, 93, 96, 97, 119 & NE-II	5,874
30	Uttarakhand	58, 72, 72A, 73, 74, 87, 94, 108, 109, 121, 123 & 125	1,991
31	West Bengal	2, 2B, 6, 31, 31A, 31C, 31D, 32, 34, 35, 41, 55, 60, 60A, 80, 81 & 117	2,524
32	Andaman & Nicobar	223	300

Source : India 2014, A Reference Annual, pp. 1065-66.

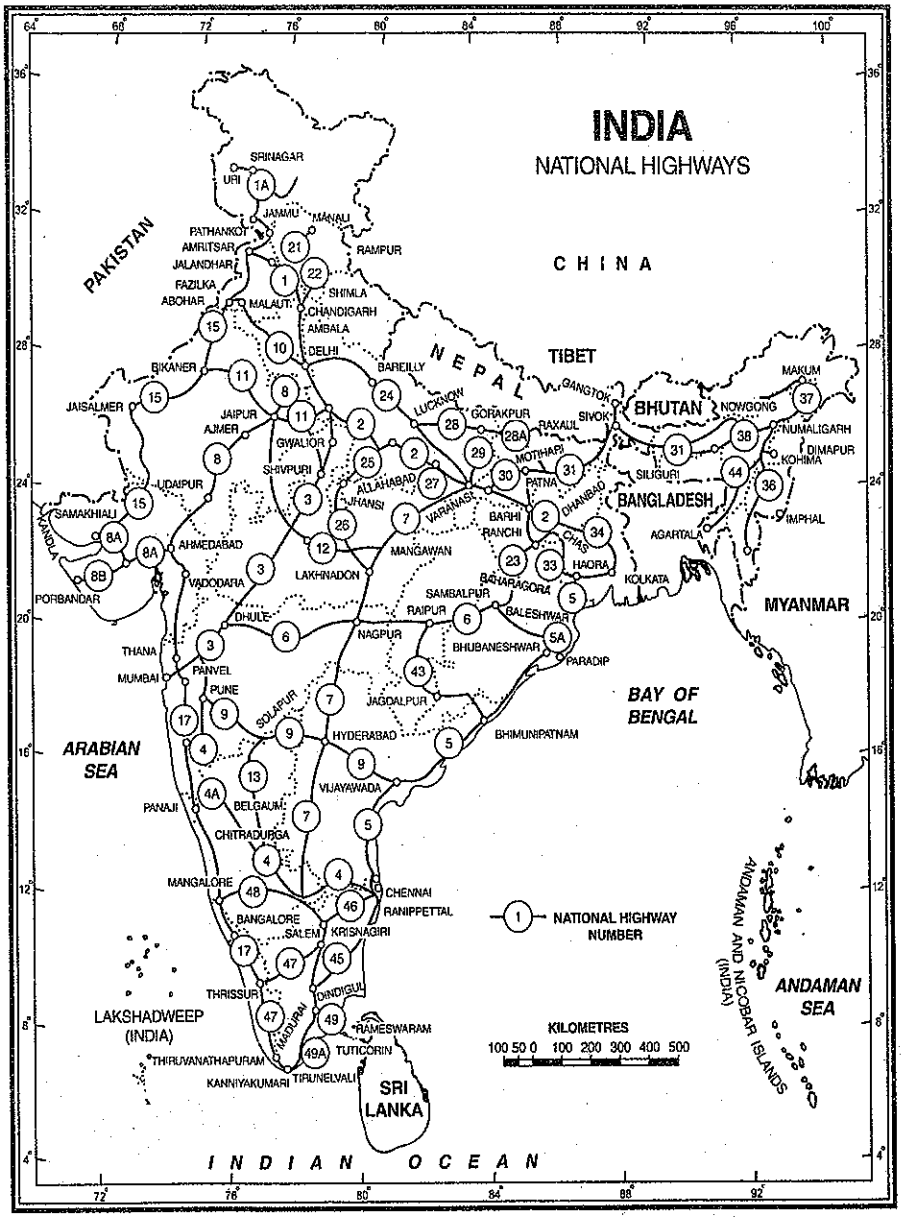

FIG. 26.5. India : National Highways

2. State Highways

These are constructed and maintained by state governments and join the state capitals with district headquarters and other important towns. These roads are also connected to the national highways. The length of state roadways in India has almost tebled within a span of about four decades and has increased from 56,765 km in 1971 to 1,63,898 km in 2011.

These roads constitute about 3.5 per cent of the total road length of India.

Although construction and maintenance of state highways is the responsibility of the concerned state governments, yet with the revamping of the Central Road Fund (CRF) in 2000, the Centre provides financial assistance for development of state roads. Further, to promote inter-state facilities and also to assist the State Governments in their economic development through construction of roads and bridges, Central Government provides 100 per cent grant for inter-state connectivity and 50 per cent grant for projects of economic importance from CRF. Loan assistance from external funding agency is also taken by some states.

The distribution of State Highways is very uneven. Maharashtra has the maximum length of state highways. This is followed by Gujarat, Madhya Pradesh, Rajasthan, and Andhra Pradesh (including Telangana). Smaller states such as Goa, and states in hilly areas like Mizoram, Sikkim, Nagaland, Tripura, etc. have less than five hundred km length of State Highways.

3. *District Roadways*

These roads join the district headquarters with the other places of the district. Development and maintenance of these roads fall within the purview of Zila Parishads. There has been more than five times increase in the length of district roadways. Formerly most of the district roads were unsurfaced and lacked bridges and culverts. But now the situation has changed and most of these roads are surfaced. Such a situation has improved connectivity and paved way for economic development.

Maharashtra is at the top followed by Uttar Pradesh, Madhya Pradesh, Rajathan, Punjab, Karnataka, Assam, Himachal Pradesh, Haryana and Kerala.

4. *Village Roads*

The village roads are mainly the responsibility of village panchayats and connect the villages with the neighbouring towns and cities. These are generally dusty tracks and are usable only during the fair weather. They become muddy and unserviceable during the rainy season. Efforts have been made in the recent past to connect the villages with metalled roads. The length of these roads has increased by about 13 times from 2,06,408 km in 1951 to 27,49,805 km in 2011. These roads accounted for over 58.6 per cent of the total road length of the country in 2011. Still about 10 per cent of the villages having a population of 1,000 or more and 60 per cent of the villages with less than 1,000 people are not connected by all-weather roads. The network needs expansion and upgradation of existing roads to all-weather roads.

A new thrust was given to village roads when the Pradhan Mantri Gram Sadak Yojna (PMGSY) was launched in December 2000. This is a 100% Centrally Sponsored Scheme to provide rural connectivity to unconnected habitations with a population of 500 persons or more (250 persons in case of hilly, desert and tribal areas) in rural areas by the end of the Tenth Plan period. The scope of PMGSY has been expanded to include both construction of new links and upgradation of existing through routes associated with such link routes to form one complete sub-network for providing connectivity between the village and the market. A survey undertaken to identify the "core network" as part of PMGSY showed that over 1.70 lakh unconnected habitations needed to be undertaken under this programme. This would require new construction of 3.68 lakh kilometres of rural roads at a total cost of ₹ 1,33,000 crore.

Border Roads. Border Roads Organisation (BRO) Board was set up in May 1960 for accelerating economic development and strengthening defence preparedness through rapid and co-ordinated improvement of roads in the north and north-eastern border areas. This organisation has constructed world's highest road joining Chandigarh with Manali in Himachal Pradesh and Leh in Ladakh. This road runs at an average altitude of 4,270 metres above sea level and negotiates four passes at heights ranging from 4,875 to 5,485 metres. It is a vital road link in the western Himalayas and has considerably reduced the distance between Chandigarh and Leh. The Border Roads Organisation has now spread its activities throughout the country and is presently working in states of Rajasthan, Jammu and Kashmir, Himachal Pradesh, Maharashtra, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, Sikkim, Assam, Meghalaya, Nagaland, Tripura, Manipur, Mizoram, Arunachal Pradesh, Bihar and Andaman and Nicobar Islands.

IMPORTANT MILESTONES

- Entrustment of construction of 8.8 km long Rahtag tunnel, related access roads to its portals and a 292 km long Alternate Route to Leh.
- Entrusted with four-laning of a stretch of NH-IA from Jammu to Vijaypur as part of NHDPs North-South Corridor on behalf of NHAI.
- Part of Phase 'A' of Special Accelerated Road Development Programme for North-East (SARDP-NE) has been entrusted to BRO. The work involves construction of new roads and improvement of existing roads along with widening of 1,103.58 km.
- Upgradation of 94 km long Srinagar-Uri Road (NH-1A) and 17.25 km long Uri-LOC road, double laning of 265 km long Batote-Kishwar-Anantnag road (NH-1B) and 422 km long Srinagar-Leh road Uri Kargil (NH-1D), construction of 290 km long Nimer-Padum-Darcha road, and widening of 14.14 km long Domel-Katra (NH-1C).
- Completed 120 metre long cut and cover tunnel at NH-44 near Sonapur in Meghalaya in 2008. It facilities uninterrupted communication at Sonapur landslide prone area during monsoons for forward areas of Meghalaya, Mizoram, Tripura and Cachar region of Assam.

A prestigious project of developing the 160 km long Tamu-Kalemyo-Kalewa road in Myanmar was taken up in 1997 and completed in 2001. Another important work is the construction of Indo-Bangladesh Border (IBB) Roads and fencing of the border.

Urban Roads. A road within the limits of the area of municipality, military cantonment, port or railway authority is called an urban road. There has been a phenomenal growth in urban roads from a meagre 46,361 km in 1961 to 4,11,840 km in 2011 as a result of accelerated growth in urbanization.

Project Roads. A road within the limits of the area of a development project of a public authority for the exploitation of resources such as forests, irrigation, hydro-power, coal, sugarcane, etc. is called a project road. Various developmental projects have been undertaken as a result of which the length of project road has increased from 1,30,893 km in 1971 to 2,88,539 km in 2011.

International Highways

The roads which are financed by the World Bank and connect India with neighbouring countries are called international highways. There are two categories of such highways. (*a*) the main arterial routes linking the capitals of neighbouring countries. Some of the important routes of this category are (*i*) the Lahore-Mandalay (Myanmar) route passing through Amritsar-Delhi-Agra-Kolkata-Golaghat-Imphal (*ii*) Agra-Gwalior-Hyderabad-Bengaluru-Dhanushkodi road and (*iii*) Barhi-Kathmandu road. (*b*) Routes joining major cities, ports etc. with arterial network such as : (*i*) Agra-Mumbai road (*ii*) Delhi-Multan road (*iii*) Bengaluru-Chennai Road and (*iv*) Golaghat-Ledo road.

Geographical Distribution of Roads

The network of roads is more or less similar to that of railways, although former far excels the later with respect to kilometreage. A look at **Figure 26.5** and shows that there are great variations in the distribution pattern of roads in India. Uttar Pradesh, Rajasthan, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka, Gujarat, Odisha and Bihar have much longer length of national highways. Incidently these are larger states with high density of population and comparatively advanced stage of industrial growth. However, length of National Highways passing through a state is not always a true index of economic well being of a state as they serve only the main routes. For example, Madhya Pradesh and Bihar have longer route length of the national highways and still have some of the most backward areas which are located far away from the main road routes.

The length of state highways could be a better index of road accessibility at the state level. The picture is slightly different with regard to state highways when compared to that of the national highways.

Maharashtra is the best served state by the state highways. Gujarat is a distant second with respect to length of state highways. The other states with sufficiently long route length of state highways are Madhya Pradesh, Rajasthan, Karnataka, Uttar Pradesh and Andhra Pradesh. The north-eastern states do not have sufficient route length of state highways.

The nature of roads, rather than their total length is more significant from the utility point of view. The largest concentration of roads is found in the Northern

Plain, especially in West Bengal and in the Punjab-Haryana plain. But the ratio of surfaced road to the total road length is lower in the Northern Plain than the national average. For example, Bihar and West Bengal are the two large states in the plain but have only 42.32 per cent and 56.48 per cent of surfaced roads to the total length of roads respectively. Uttar Pradesh with 68.74 per cent of the surfaced roads is in a slightly better position. Punjab and Haryana are the two richest states of the country and have 100 per cent and 94.83 per cent of the surfaced roads respectively. The main cause of small proportion of surfaced roads in the Northern Plain is that it is made up of sand, silt and clay and there is shortage of stone for constructing surfaced roads. In contrast, the proportion of surfaced roads is much higher in the Peninsular plateau area because it is composed of hard rocks and stone for constructing roads is readily available here in plenty. Gujarat (93.95%), Maharashtra (79.68%), Goa (61.00%) are some of the states having higher than the national average of 60.33 per cent. Odisha presents an anomaly and is the poorest of all the states where surfaced roads account for less than one-third of the total length of roads. Among the Himalayan states Sikkim with 86.11 per cent is at the top and this is followed by 70.97 per cent in Jammu and Kashmir. All other Himalayan states have surfaced roads less than the national average. Among the union territories, Chandigarh, Dadra and Nagar Haveli, Daman and Diu. Delhi and Lakshadweep have 100 per cent surfaced route. This is followed by 97.47 per cent in Andaman and Nicobar Islands and 77.09 per cent in Pondicherry.

Density of Roads

A still better index of road accessibility is the *density of roads* which is defined as the length of roads per 100 sq km of surface area.

The Himalayan region, western Rajasthan and North-eastern states have low to very low density of road network. Most of these parts are served by roads constructed by Border Roads Organisation.

It varies from 10.0 km per 100 sq km in Jammu and Kashmir to 526.9 km per 100 sq km in Kerala with a national average of 96.5 km per 100 sq km (2013). Density of 200 to 400 km per 100 sq km is found in Assam, Goa, Tripura and West Bengal. Andhra Pradesh, Bihar, Karnataka, Nagaland, Odisha,

TABLE 26.11. State-wise Road Density per 100 sq km (2013)

State	Length of roads per 100 sq km
1. Andhra Pradesh (including Telangana)	125.4
2. Arunachal Pradesh	19.6
3. Assam	293.6
4. Bihar	127.5
5. Chhattisgarh	55.0
6. Goa	285.5
7. Gujarat	74.8
8. Haryana	67.2
9. Himachal Pradesh	65.2
10. Jammu & Kashmir	10.0
11. Jharkhand	21.9
12. Karnataka	133.2
13. Kerala	526.9
14. Madhya Pradesh	53.8
15. Maharashtra	72.6
16. Manipur	73.2
17. Meghalaya	43.9
18. Mizoram	29.2
19. Nagaland	134.5
20. Odisha	138.4
21. Punjab	89.7
22. Rajasthan	50.1
23. Sikkim	26.4
24. Tamil Nadu	139.3
25. Tripura	302.6
26. Uttar Pradesh	118.2
27. Uttarakhand	76.7
28. West Bengal	238.6
All States	**95.8**
Union Territories	
1. Andaman & Nicobar Islands	15.8
2. Chandigarh	1,857.9
3. Dadra & Nagar Haveli	128.7
4. Daman and Diu	200.0
5. Delhi	1,993.2
6. Lakshadweep	525.0
7. Puducherry	562.8
All Union Territories	**334.8**
All India	**96.5**

Tamil Nadu and Uttar Pradesh have road density varying from 100 to 200 km per 100 sq km. These two sets of states have moderate to high road density due to high level of urbanization and industrialisation. Level land of the Great Plain of North India provides ideal conditions for road construction but building material for road has to be transported from hilly region of the Himalayas or from the northern part of the plateau region as this plain is entirely made up of sand, silt and clay. On the other hand, the Himalayan region abounds in building material but rugged topography and rough terrain hampers the process of

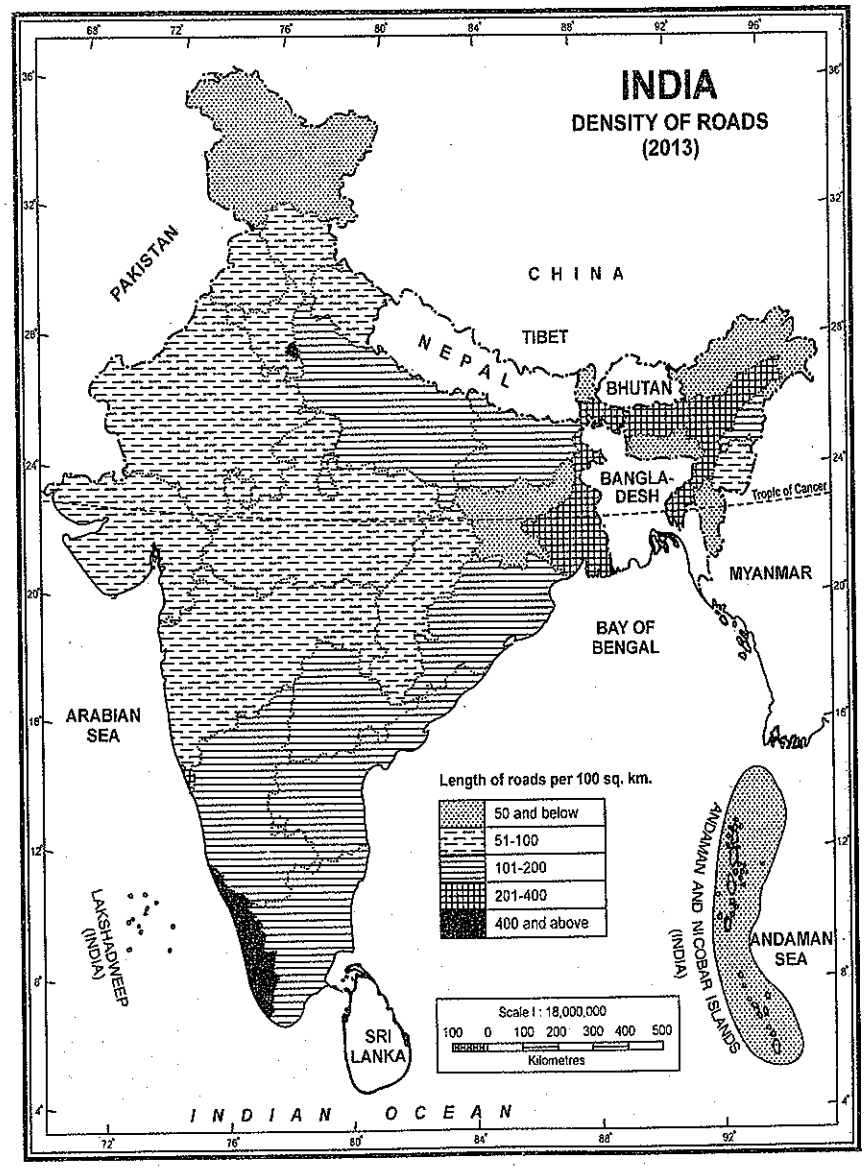

FIG. 26.6. India : Road Density (2013)

road building. This is the reason that most of the Himalayan states like Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Meghalaya, Manipur etc. have low density of roads. Most of the Union Territories are of small size and some of them are highly urbanized. As such they have high road density except Andaman and Nicobar Islands.

Problems and Prospects

Road transportation in India faces a number of problems. Keeping in view the vastness of the dimensions of the country, her physiography, her unlimited natural resources and the fast growing passenger and freight traffic, inadequacy of road network is quite glaring. India's road length of 96.5 km per 100 sq km of area is desperately low as compared to 294.6 km in Japan, 131.2 km in Austria, 451.8 km in Belgium, 147.2 km in France and 172.2 km in Switzerland. Again, India has low road length of 379.3 km per one lakh population as against 893.6 in Japan, 497.2 in Malaysia, 1277.7 in Saudi Arabia, 1392.4 in Austria, 1556 in Hungary, 1572.4 in Sweden, 2494.5 in the USA, 3184.9 in Canada, 4635.4 in Australia and 2705.7 in New Zealand. Lakhs of villages in remote areas are still awaiting a road to reach them.

Another problem is that a little less than half of the roads (40%) are unsurfaced. They can be used only in fair weather and become muddy and unfit for transportation during the rainy season. Efforts need to be made to construct as many surfaced roads as is practically possible.

The national highway network will have to be improved to meet the growing traffic of men and materials. A large section has insufficient road pavement thickness. Other deficiencies are inadequate capacity; poor riding quality, weak and distressed bridges/culverts, congested city sections, too many railway level crossings, lack of wayside amenities and weak road safety measures. About 20 per cent of national highways need widening from single to double lanes and 70 per cent of two lane roads have to be strengthened and selected corridors on national highways need conversion into *expressways*. This is clearly an enormous task and needs huge capital investment which is beyond the capacity of the public sector. Consequently, National Highway Act was amended in 1995 for encouraging private sector to participate in the construction, maintenance and operation of roads on Build, Operate and Transfer (BOT) basis.

The future challenge in road sector revolves around building all-weather roads connecting each and every village to a State Highway or a National Highway. It is imperative to strengthen the road infrastructure for carrying rapidly increasing volumes of agricultural produces to the consuming centres in the near future. *Rural development is closely associated with road development.*

Another very important factor to be considered is the rapidly growing population of motor vehicles and increasing commerce. The number of registered vehicles increased from 306 thousand in 1950-51 to 1,59,491 thousand in 2011-12, thereby registering over 521 times increase in a span of six decades (**Table 26.12**). However, carrying capacity of our roads has not been able to keep with the increase in vehicles. This has led to traffic jams, delays and environmental pollution. The most disturbing factor is that population of motor vehicles is likely to increase at an accelerated rate in the near future. As such there is an urgent need to take steps to increase the capacity of roads.

Building adequate road infrastructure to accelerate the pace of economic progress is an uphill task and requires huge sums of money. The current

TABLE 26.12. Number of Registered Vehicles in India

(*in thousands*)

Year	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2008-09	2009-10	2010-11	2011-12
All vehicles	306.0	665.0	1,865.0	5,391.0	21,374.0	54,991.0	1,14,051	1,27,746	1,41,866	1,59,491
Goods vehicles	82.0	168.0	343.0	554.0	1,356.0	2,948	6,041	6,432	7,064	7,658
Buses	34.0	57.0	94.0	162.0	331.0	634.0	1,486	1,527	1,604	1,677

Source : The Economic Survey 2013-14, Statistic Appendix, p.31.

estimates suggest that the cost of a four-lane highway works out at roughly ₹ 4.5 crore per kilometre and the cost of a protected access, six-lane express way works out at roughly ₹ 8.5 crore per kilometre. Funds on such a gigantic scale are managed by encouraging private participation, World Bank and imposing cess on fuel, etc.

AIR TRANSPORT

Air transport is the fastest mode of transport which has reduced distances and has led to drastic shrinking of the world. This mode of transport is indispensable when speed and time are the main constraints. One can easily cross and reach remote, inaccessible and hostile areas like lofty mountains, thick forests, marshy areas and sandy deserts by air transport which is almost impossible by other modes of transport. Air transport plays a vital role in times of emergency as well as in the event of natural and man-made calamities like floods, famines, epidemics and wars. Air transport is very essential for a vast country like India where distances are so long and the terrain and climatic conditions so diverse. The weather conditions in India are also quite congenial to air transport. Poor visibility due to clouds, fog and mist hinders air transport but India is lucky to have clear weather for most part of the year except for a short duration in rainy season and foggy winters particularly in North India.

Air transportation in India made a humble beginning in 1911 when air mail operation commenced over a very short distance of 10 km between Allahabad and Naini. The British, French and Dutch introduced air transport in 1929-30. Indian National Airways was formed in 1933 and it introduced air service between Karachi and Lahore. By the end of the World War II, major cities like Karachi, Mumbai, Delhi, Kolkata, Lahore and some other places were provided with air services. At the time of partition of the country in 1947, there were four companies namely Tata Sons Ltd./Air India, Indian National Airways, Air Services of India and Deccan Airways. By 1951, four more companies *viz.* Bharat Airways, Himalayan Aviation Ltd., Airways India and the Kalinga Airlines also came up. In 1953, the air transport was nationalised and two corporations were formed: Air India International and the Indian Airlines. The face of Indian aviation is changing and is poised for a vibrant growth. India can definitely boast of a boom in air travel. Economic liberalisation has totally changed the outlook of a perspective air passenger. Now, he thinks in terms of time and gone are the days when he used to ponder over advantages and disadvantages of air travel.

The civil aviation sector in India has recorded an unprecedented growth in the recent years. Currently there are large number of companies providing passenger transport and cargo handling services in the country. The Air Transport Companies are both in public sector and in the private sector. In the public sector, there is Air India Limited, and its subsidiaries *viz.* Alliance Air, Air India Charters Ltd. (Air India Express etc.) Among the private players, Jet Airways (India) Ltd., Jetlite Airlines, Go Airlines (Indigo) Pvt. Ltd., Spice Jet Ltd., Inter Global Aviation Ltd. (Indigo) and Air Asia are operating on the domestic sector providing wide choice of flights and connectivity to various parts of the country.

The market share of major airlines is shown in **table 26.13.**

TABLE 26.13. The market share of major airlines

Name	Percentage Share
1. Indigo	27.2
2. Air India (Domestic)	19.3
3. Spice Jet	18.5
4. Jet Airways	18.1
5. Go Air	7.6
6. Jet Lite	5.7
7. King Fisher	3.5
8. Mantra	0.1
Total	100.00

Source : Statistical Year Book India 2013, p. 320.

Three Cargo airlines *viz.* Blue Dart Aviation Pvt. Ltd., Deccan Cargo and Export Logistics (Pvt. Ltd. and M/s Quickjet are operating scheduled cargo services. Besides there are 139 companies (as on 18-6-2012) holding non-scheduled air transport operators permit.

1. Air India is responsible for international air services. It operates from international airports and connects India with almost all the continents of world through its services. Its main services are to the USA, Canada, Europe, the Russian Cofederation, the

Gulf/Middle East, East Asia, Far East, Africa and Australia. Its fleet has almost trebled from 13 air craft in 1960-61 to 34 in 2005-06. The number of passengers carried by Air India has increased manifold from 1.25 lakh in 1960-61 to 44.40 lakh in 2005-6. Endeavour has been made to enhance the operation of international sectors especially the Gulf routes which yield more profits.

TABLE 26.14. Growth of Civil Aviation in India

Year	Unit	1960-61	1970-71	1980-81	1990-91	1999-00	2004-05	2010-11	2011-12	2012-13	2013-14
1. Total fleet strength											
(*i*) Air India		13	10	17	24	26	36				
(*ii*) Indian Airlines		88	73	49	56	53	61				
(*iii*) Air India Ltd. (Erstwhile National Aviation Company of India Ltd.)								98	91	95	99
2. Revenue tonne kilometers	(₹ crore)										
(*i*) Air India		7.56	27.52	98.01	138.10	145.65	221.80				
(*ii*) Indian Airlines		10.00	20.00	40.03	69.92	74.03	101.73				
(*iii*) Air India Ltd. (Erstwhile National Aviation Company of India Ltd.)								367.70	360.30	3346.00	3910.00
3. Number of passengers carried	(Lakh)										
(*i*) Air India		1.25	4.87	14.18	21.61	33.50	44.40				
(*ii*) Indian Airlines		7.90	21.30	54.29	78.66	59.30	71.32				
(*iii*) Air India Ltd. (Erstwhile National Aviation Company of India Ltd.)								127.80	134.30	141.83	154.06
4. Passengers handled at	(Lakh)										
AAI Airports		na	na	107.38	177.23	390.35	592.84	596.43	684.00	683.87	717.8
Joint Venture Int'l Airports								837.87	939.00	910.14	972.68
Total at Indian Airports								1434.3	1623.1	1594.0	1690.48
5. Cargo handled at	(Thousand										
AAI Airports	tonnes)										
AAI Airports		na	na	178.70	377.33	797.41	1278.47	726.52	703.43	650.41	636.48
Joint Venture Int'l Airports								1621.92	1576.56	1540.14	1641.43
Total at Indian Airports								2348.44	2279.99	2190.55	2277.91

na : data not available

Source : Economic Survey 2013-14, Statisical Appendix, p. 31.

The Government of India approved a Turn Around Plan (TAP) and Financial Restructuring Plan (FRP) for improving the operational and financial performance of Air India in April 2012. The company took several initiatives towards cost-cutting and revenue enhancement during 2011-12. Some of the major steps taken are route rationalization, phasing out and grounding of old fleet, freezing of employment in non-operational areas, leveraging assets of the company to increase MRO (maintenance, repair and overhaul) revenue and revenue form real estate properties of the company.

2. Indian Airlines handles domestic traffic and carries passengers, cargo and mail to different places in the country. It also provides services to 12 countries, *viz*., Pakistan, Maldives, Nepal, Sri Lanka, Malaysia, Bangladesh, Thailand, Singapore, U.A.E.,

TABLE 26.15. Distribution of International Airports in India as on March 31, 2014

State	City Served	Name of the Airport
1. Andaman and Nicobar Islands	Port Blair	Veer Savarkar International Airport
2. Andhra Pradesh	Vishakhapatnam	Vishakhapatnam Airport
3. Assam	Guwahati	Lakpriya Gopinath Bordoloi International Airport
4. Chhattisgarh	Raipur	Swami Vivekanand Airport
5. Delhi	New Delhi	Indira Gandhi International Airport
6. Goa	Whole state	Goa International Airport
7. Gujarat	Ahmedabad	Sardar Vallabhbhai Patel International Airport
8. Jammu and Kashmir	Srinagar	Srinagar Airport
9. Karnataka	Bengaluru	Kempegowda International Airport
10. Karnataka	Mangalore	Mangalore International Airport
11. Kerala	Kochi	Cochin International Airport
12. Kerala	Kozhikode	Calicut International Airport
13. Kerala	Thiruvananthapuram	Trivandrum International Airport
14. Madhya Pradesh	Bhopal	Raja Bhoj Airport
15. Madhya Pradesh	Indore	Devi Ahilyabai Holkar Airport
16. Maharashtra	Mumbai	Chhatrapati Shivaji International Airport
17. Maharashtra	Nagpur	Dr. Babasaheb Ambedkar International Airport
18. Manipur	Imphal	Tulibal International Airport
19. Odisha	Bhubaneshwar	Biju Patnaik International Airport
20. Punjab	Amritsar	Sri Guru Ram Das Jee International Airport.
21. Rajasthan	Jaipur	Jaipur International Airport
22. Rajasthan	Udaipur	Maharana Pratap Airport
23. Tamil Nadu	Chennai	Chennai International Airport
24. Tamil Nadu	Coimbatore	Coimbatore International Airport
25. Tamil Nadu	Tiruchirappali	Tiruchirapalli International Airport
26. Telangana	Hyderabad	Rajiv Gandhi International Airport
27. Uttar Pradesh	Lucknow	Chaudhary Charan Singh Airport
28. Uttar Pradesh	Varanasi	Lal Bahadur Shastri Airport
29. West Bengal	Kolkata	Netaji Subhash Chandra Bose International Airport
30. West Bengal	Silguri	Bagdogra Airport

Source : Airport Authority of India, 2014.

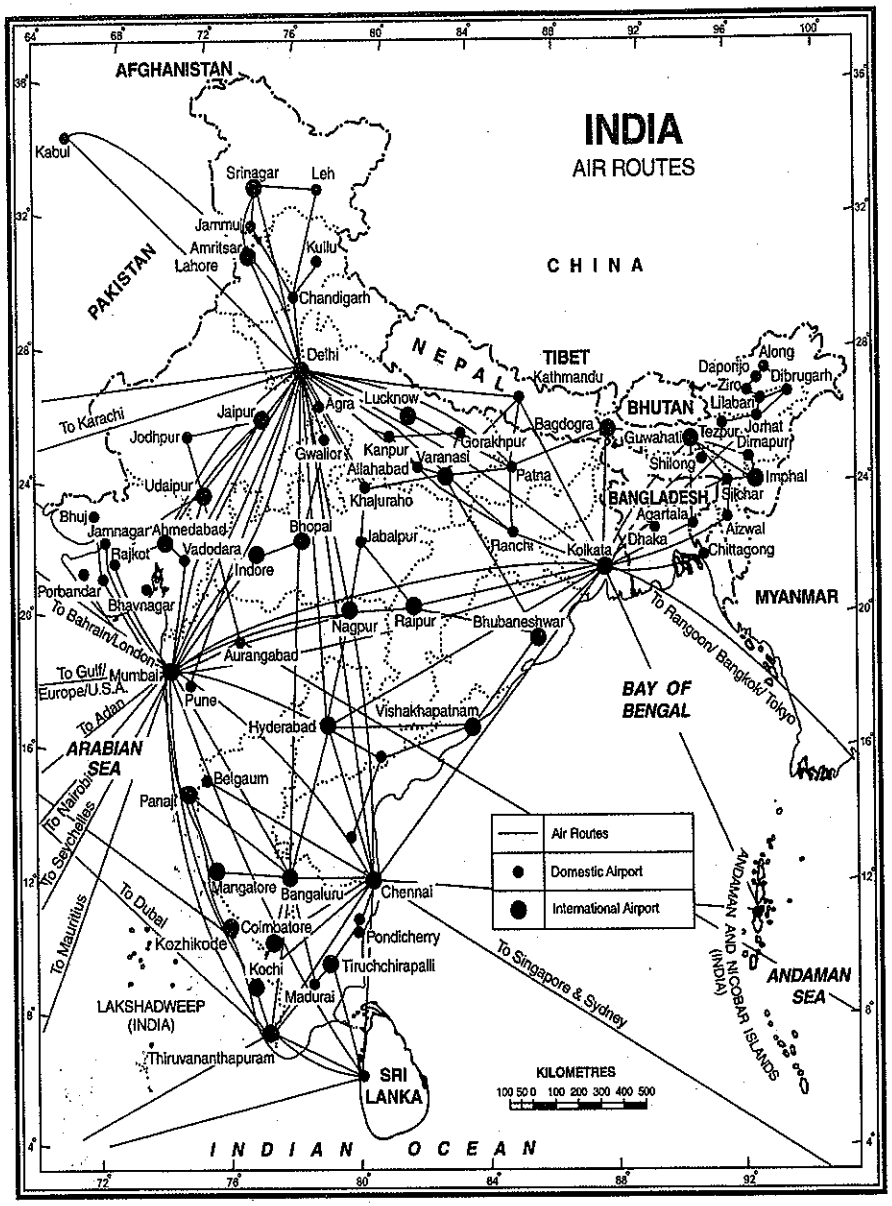

FIG. 26.7. India : Air Routes

Oman, Myanmar and Kuwait. Its operations cover 69 destinations including 15 abroad. Its fleet strength has shown varying trends, falling from 88 in 1960-61 to 73 in 1970-71 and 49 in 1980-81. It rose to 53 in 1999-2000. In 2005-06, its fleet stood at 64. The current projections indicate additional aircraft requirements for replacement of ageing aircraft as well as for growth. The number of passengers carried by Indian Airlines rose dramatically from a modest of 7.9 lakh in 1960-61 to 78.66 lakh in 1990-91 but fell to 78.61 lakh in 2005-06.

3. Vayudoot was set up in 1981 to augment the air transport in the country. It provided links with remote and inaccessible areas which were not covered by Indian Airlines. It commenced its services in February, 1981. The Government had initially approved air services to 14 stations in the North-Eastern region. Subsequently, 23 stations outside this region were added for linking by Vayudoot. Its fleet rose from 1 in 1981 to 20 in 1988-89 but fell to 16 in 1992-92 after which it was merged in Indian Airlines. Its network which linked remote, inaccessible and thickly forested areas of the North-Eastern region has been taken over by the newly created Short Haul Operations Deptt. of Indian Airlines.

4. Pawan Hans Limited was established in 1985. It provides helicopter services to the petroleum sector including ONGC, Oil India Ltd. and Enron Oil and Gas, Mumbai High and connects remote and inaccessible areas. The company has a strong presence in North-East having its helicopters deployed in the states of Arunachal Pradesh, Meghalaya, Sikkim and Tripura. Apart from this it also provides services to certain state governments such as Punjab, M.P., Lakshadweep and public sector undertakings like NTPC., GAIL, and BSF.

Private Sector. Private taxis started their services in 1990 and played feeder role to Indian Airlines. Only four parties ventured in this area at that time due to the restrictive environment. In a major policy change, the Government repealed the Air Corporation Act 1953 on March 1, 1994, thereby ending the monopoly of Indian Airlines and Air India on the scheduled operations. Private operators, who were hitherto operating as air taxis, have since been granted scheduled airlines status. The new policy on air taxi services provides for a route dispersal plan to ensure operation of a minimum number of services in the North-Eastern Region, Andaman and Nicobar Islands, Lakshadweep and Jammu and Kashmir. This policy has infused competitive environment between Indian Airlines Ltd., a public sector enterprise, on one hand and private operators on the other hand. The policy on domestic air transport service was approved in April 1997 according to which barriers to entry and exit from this sector have been removed.

Airport Authority of India (AAI)

International Airports Authority of India and National Airports Authority were merged on 1 April, 1995 to form Airports Authority of India (AAI). This authority is responsible for providing safe and efficient air traffic services and aeronautical communication services for effective control of air traffic in the Indian air space. It controls and manages the entire Indian space even beyond the territorial limits of the country in accordance to the norms set by International Civil Aviation Organisation (ICAO). It comprises of International Airport Division (IAD) and National Airports Division (NAD).

At present India has 450 air ports/air ships of which 30 are international. There are 26 Civil Enclaves (3 international, 4 customs and 19 domestic) as well as 31 non-operational domestic airports. The distribution of international airports is given in **table 26.15**.

The International Airports Division (IAD) of AAI operates and develops international airports. It has undertaken construction of terminal complexes at various international airports and improvement and upgradation of runways and terminal buildings. National Airport Division (NAD) looks after domestic airports. A number of projects like modernisation of air traffic services at Mumbai and Delhi airports, installation of airport surveillance radar at Ahmedabad, Guwahati, Hyderabad and Thiruvananthapuram, development of 12 model airports for upgradation of facilities and improvement in the quality of services at airports have been taken up. Development works in other remote areas like Jammu and Kashmir, Lakshadweep, Himachal Pradesh and Andaman and Nicobar Islands are also being taken up.

The improvement of infrastructure at the airports needs heavy capital investment which the government cannot afford of its own. Therefore, private domestic and foreign investors including NRIs have been encouraged to participate in the process of improvement. Improvement and modernization of Indira Gandhi International Airport at Delhi and Shivaji Maratha International Airport at Mumbai Chennai International Airport and Netaji Subhash Chandra Bose International Airport are some of the outstanding examples.

WATER TRANSPORT

Inland waterways were the chief mode of transportation before the advent of railways. Waterways are the cheapest means of transport and are most suitable for carrying heavy and bulky materials having low specific cost. Water transport is a fuel efficient and environment friendly mode of transportation which has vast employment generation potential. Water transport suffered a great deal at the hands of roads and railways because it could not compete with the speed of road and rail transport. Although efforts are being made to revive the inland waterways, yet this mode of transportation is at its initial stage. Waterways provide only one per cent of total transport of India. The total length of navigable waterways in India comprising rivers, canals, backwaters, creeks, etc. is 14,500 km, out of which only 3,700 km is navigable by mechanised boats. Only 2,000 km is actually used. As regards canals, we have a network of about 4,300 km of navigable canals, of which a stretch of 900 km is navigable by mechanised crafts. The emerging scenario shows that the inland waterways are greatly underutilised.

National Waterways

In order to increase the significance of inland waterways and to improve their efficiency, the Government has identified 10 important waterways which are to be given the status of National Waterways. Some headway has already been made in this regard.

Followng five inland waterways have so far been declared as national waterways (NW).

In addition, declaration of Barak river from Lakhpur to Bhanga (121 km) as sixth National Waterway is under consideration of the Government.

Ganga is the most important inland waterway in India. It is navigable by mechanised boats upto Patna and by ordinary boats upto Hardwar. It has been declared as National Waterway No. 1. The entire route has been divided into three parts for development purposes. These parts are Haldia-Farakka (560 km), Farakka-Patna (460 km) and Patna-Allahabad 600 km). The National Waterways (Allahabad-Haldia stretch of Ganga-Bhagirathi-Hooghly River system) Act, 1982 has the provision that the regulation and development of this waterway is the responsibility of the Central Government.

Brahmaputra is also navigable by steamers upto Dibrugarh for a distance of 1,384 km which is shared by India and Bangladesh. Its 891 km long stretch from Sadiya to Dhubri in Assam has been declared as a National Waterway and is being developed as an important inland waterway.

Rivers of South India are seasonal and are not much suited for navigation. However, the deltaic areas of the Godavari, the Krishna and the Mahanadi,

TABLE 26.16. National Waterways of India

Waterways	Stretch	Specification	Date of declaration
NW 1	Allahabad-Haldia stretch (1,620 km)	It is one of the most important waterways in India, which is navigable by mechanical boats up to Patna and by ordinary boats up to Haridwar. It is divided into three parts for developmental purposes — (*i*) Haldia-Farakka (560 km), (ii) Farakka-Patna (460 km), (*iii*) Patna-Allahabad (600 km).	27.10.1986
NW 2	Sadiya-Dhubri stretch (891 km)	Brahmaputra is navigable by steamers up to Dibrugarh (1,384 km) which is shared by India and Bangladesh.	26.10.1988
NW 3	Kottapuram-Kollam stretch (205 km)	It includes 168 km of west coast canal along with Champakara canal (23 km) and Udyogmandal canal (14 km).	01.02.1991
NW 4	Kakinada Puducherry (1995 km)	Stretch of canal and Kalurelly Tank stretches of river Godavari and Krishna.	2008
NW 5	Talcher Dhamra (585 km)	Stretch of river Brahmani Geonkhali Cherbatia stretch of East coast canal, Charbectia Dharma. Stretch of Matai river alongwith Mahanadi delta river system	2008

Source : Compiled from India 2012 *A Reerence Annual*, p. 1090-91.

lower reaches of the Narmada and the Tapi, back waters of Kera Mandovi and Juari rivers of Goa serve as waterways. The Godavari is navigable upto a distance of 300 km from its mouth. The Krishna is used as a waterway upto 60 km from its mouth.

There are some navigable canals also which serve as inland waterways. Buckingham canal in Andhra Pradesh and Tamil Nadu is one such canal which provides water transport for a distance of 413 km. It runs parallel to the eastern coast and joins all the coastal districts from Guntur to South Arcot. The other navigable canals are Kurnool-Cuddapah Canal (116.8 km), Son Canal (326 km), Odisha Canal (272 km), Medinipur Canal (459.2 km), Damodar Canal

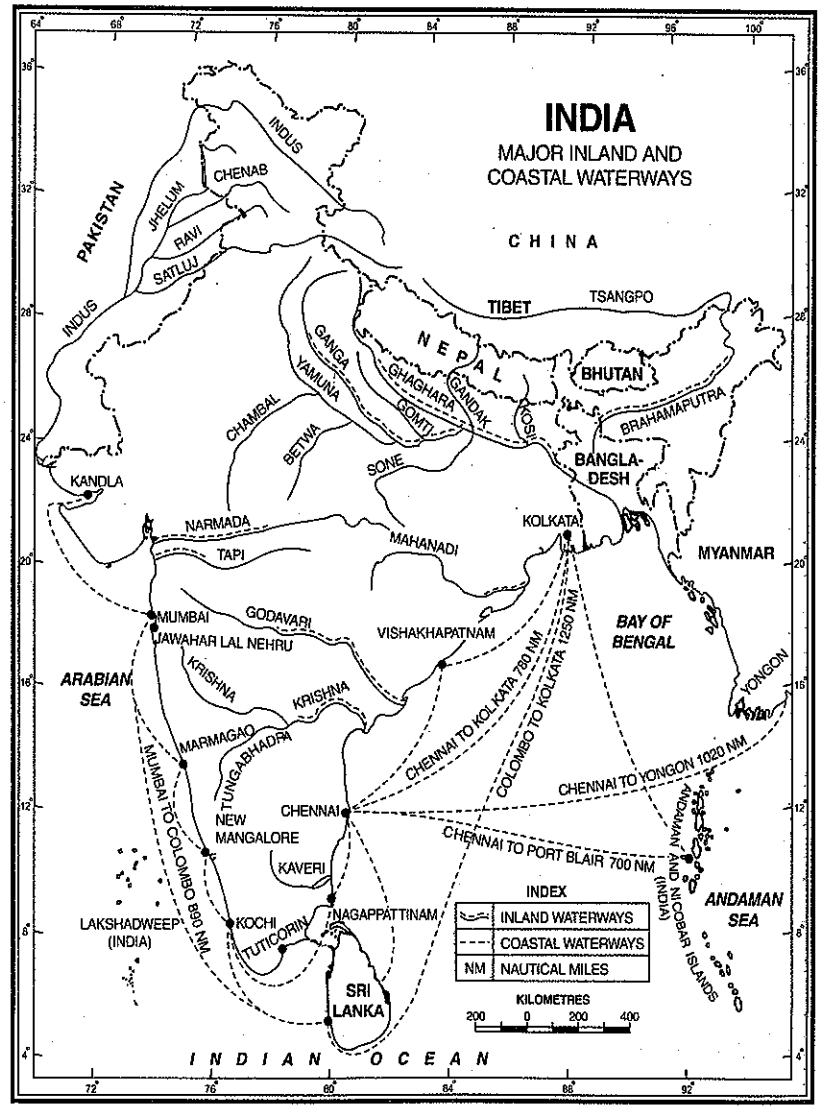

FIG. 26.8. India : Major Inland and Coastal Waterways

(136 km). Some of the irrigation canals of Uttar Pradesh and Punjab are also utilised for local transport.

The Inland Waterways Authority of India (IWAI) was set up at Noida (Uttar Pradesh) on 27 October, 1987 for development and regulation of inland waterways. The Authority undertakes various schemes for development of Inland Water Transport (IWT) related infrastructure on National Highways.

Factors affecting Inland Waterways

1. The rivers and canals should have regular flow of sufficient water.

2. The presence of waterfalls, cataracts and sharp bends in the course of river hinders the development of waterways.

3. Silting of the river bed reduces the depth of water and creates problems for navigation. Desilting of river beds is a costly affair.

4. Diversion of water for irrigation purposes reduces the quantity of water in the river channel and should be done carefully.

5. There should be sufficient demand for waterways to make it economically viable mode of transportation.

SHIPPING

India had a glorious past with respect to shipping. Indian maritime trade flourished in ancient times. Indian boats and ships have been sailing in the Indian Ocean for the last 4,000 years taking merchandise to East Indies and Middle East. The Indian shipping got a serious setback with the arrival of European companies. However, necessity to develop shipping was realised during the First World War. Consequently, the Scindia Steam Navigation Co. was set up in 1919. At the time of Independence, there were only 59 ships with less than 2 lakh tonnes of GRT (Gross Registered Tonnage). Shipping in India has made considerable progress in the post-independence period.

Currently shipping plays a significant role in the transport sector of the country's economy. Nearly 90 per cent of India's trade volume (77 per cent in terms of value) is moved by sea making shipping the backbone of trade and economic growth. Today, India has the largest merchant shipping fleet among the developing countries and ranks 17th amongst the countries with the largest cargo carrying fleet. As on 31st January, 2013, Indian tonnage stood at 10.45 million GRT (Gross Registered Tonnage) with 1,158 ships. It is estimated that the present fleet strength is not adequate to support the trade flow in shipping sector. Therefore, there is an urgent need for augmenting the tonnage capacity in the coastal sector to meet the increasing demand.

Coastal Shipping. Coastal shipping involves movement of goods and passengers from one port to another port within a country. It is quite distinct from overseas (shipping from one country to another) or offshore that implies shipping to locations of the shore such as oil rigs and platforms. Developing coastal shipping has many advantages. It decongests the railways and roadways, is relatively pollution free, is less capital intensive, provides large employment, involves continuous vigilance of the coasts and promotes sea based industries such as fisheries and luxury tourism.

The peninsular shape of south India offers great opportunities for coastal shipping. The 7516.6 km long coastline of India is studded with 13 major and 200 non-major ports providing congenial and favourable conditions for the proper development of coastal shipping. Indian ports have a vast hinterland of about 3,80,000 sq km which provides sufficient support for shipping. Most of the medium and minor ports of India are underutilised in terms of their potential. Proper utilisation of the potential of these ports can result in large scale saving. The eastern and western coasts of India can operate as two independent coastal area zones, sailing north-south to take advantage of long coastline and the multitrade of ports on each side. It is important to note that most of the large and industrialised states like Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal have a long coastline and a large number of minor ports. As such these states have great potential for improving coastal shipping.

Land transport involves huge capital expenditure —both initially and subsequently on maintenance— on roads and tracks, mobile equipment with high fuel consumption. A recent study of fuel costs involved in moving general or bulk cargo from Mumbai to Goa showed that sea mode was nine times less expensive than the road route.

Action plan for the development of coastal shipping is already on the anvil with the Central Government with a view to promote coastal shipping and sailing vessel industry, the home trade vessels and sailing vessels have been exempted from the payment of lighthouse dues. Meanwhile, a study has already been completed by the Tata Consultancy Services (TCS) to assess the potential of coastal shipping and the role of minor ports keeping in view the feasibility of routes and supporting environment needed for its development. Its report has been accepted by the Government in principle.

PORTS

There are 13 major and 200 medium and small ports in India. The major ports are under the supervision of the Central Government while the minor ones are managed by the concerned State Governments. The 13 major ports handle about 90% of our foreign trade. The major ports on the west coast are Mumbai, Jawaharlal Nehru, Kandla, Marmagao, Mangalore and Kochi while on the east coast are Kolkata/Haldia, Paradwip, Vishakapatnam, Chennai, Ennor and Tuticorin. The number of cargo vessels handled at major ports is about 16,000 per annum. The aggregate cargo handled at major ports during 2012-13 was nearly 545790 thousand tonnes which increased to 555448 thousand tonnes in 2013-14 (**Table 26.17**).

TABLE 26.17. Traffic handled at Indian Ports ('000 tonnes)

	Traffic handled		Growth over previous year	
	2012-13	2013-14	2012-13	2013-14
Major ports	545790 (58.5)	555488 (56.7)	-2.6	1.8
Non-major ports	387867 (41.5)	425000 (43.3)	9.8	9.6
All ports	933657 (100)	980488 (100)	2.2	5.0

Note : Figures in parenthesis are in percentages.

Source **:** Economic Survey 2013-14, p. 203.

A brief description of major ports of India is given here :

1. Mumbai. It is a magnificent natural harbour on the West Coast of India. The deep 10-12 metre sea adjoining the harbour with no sand banks enables big ships to enter the port easily. It handles approximately one-fifth of India's foreign trade with predominance in dry cargo and mineral oil from the Gulf countries. It is the biggest port of India. It handles foreign trade with the Western countries and East African countries. The opening of the Suez Canal in 1869 brought it much closer to the European countries.

This port has a fully integrated multipurpose port handling container, dry bulk, liquid bulk and break bulk cargo. It has extensive wet and dry dock facilities to meet the normal needs of ships using the port. There are three enclosed wet docks having a total area of 46.30 hectares and quayage of 7,776 metres inside the wet basin and 853 metres along the harbour wall.

Mumbai has a vast hinterland covering the whole of Maharashtra and large parts of Madhya Pradesh, Gujarat, Rajasthan and Delhi. This hinterland is very rich in agricultural and industrial resources. The entire hinterland has undergone large scale economic improvement which has helped in the rapid growth of this port. A dense network of roads and railways connects the port with its hinterland.

Mumbai is the gateway to India from the west and handles large scale trade of great variety. The major items of export are cotton textiles, leather, tobacco, manganese, machinery, chemical goods etc. while the imports include crude oil, superior quality raw cotton, latest machines, instruments and drugs. This port is likely to progress further with the economic development of its hinterland.

2. Jawaharlal Nehru Port. Formerly known as *Nhava Sheva port*, this port was opened on 26th May, 1989. This new port has been built at an island named Nhava Sheva across the famous Elepthanta caves, about 10 km from Mumbai. Built at the cost of ₹ 880 crore, this port is named Jawaharlal Nehru port as a tribute to the first prime minister of India. The main purpose of this port is to release pressure on the Mumbai port. The port is equipped with the most modern facilities having mechanised container berths for handling dry bulk cargo and service berth etc. Most of the operations are conducted with the help of computers. The port is linked by road and rail to other

railway routes and National Highways avoiding Mumbai city altogether. The initial capacity of the port was 5.9 million tonnes in 1995-96 which was raised to 9.9 million tonnes in 1997-98. The first private sector project Nhava Sheva International Container Terminal (NSICT) became operational in 2000. This terminal has already captured a substantial share of container handling not only in the region but also among all the major ports of the country. The sea is quite deep near the port and there is no need for dredging in this port.

Jawaharlal Nehru Port Trust (JNPT) Navi Mumbai, signed an agreement with P&O Australia, for development of a two berth container terminal on

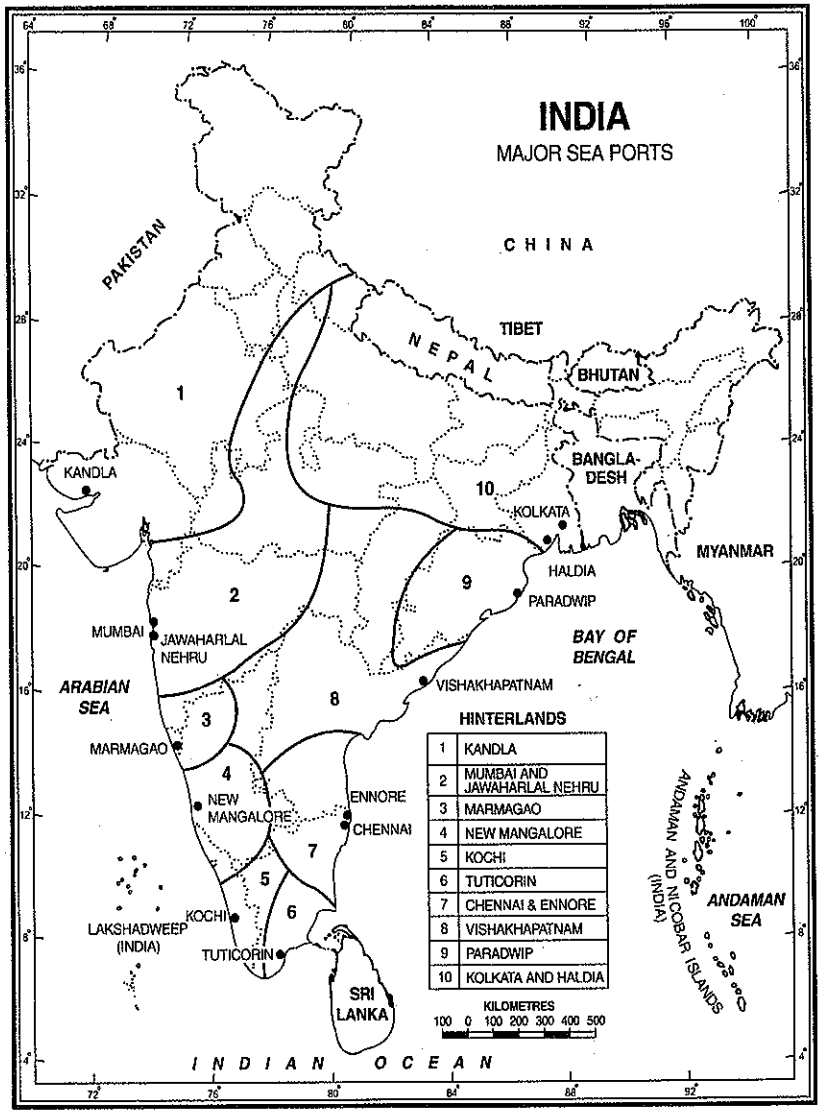

FIG. 26.9. India : Major Sea Ports

'Build, Operate and Transfer' (BOT) basis for a period of 30 years in July, 1997. The work was completed in April 1999 at the cost of ₹ 900 crore. Another agreement was signed on August 10, 2004 with Gateway Terminals India Pvt. Ltd. for development of the third container terminal which will result in addition of 1.3 million TEUs (twenty feet equivalent units) container handling capacity of the port. JNPT is also taking preparatory action for setting up of fourth container terminal.

As a result of the above mentioned initiatives taken to enhance its capacity, Jawaharlal Nehru port has come to rank 28th among the world class container ports. Currently the port handles 55-60 per cent of the country's containerised cargo. This port handled vessels having drought upto 12.5 metres in 2011-12.

It is a twin port of Mumbai so far its hinterland is concerned.

3. Kandla. This port is located at the eastern end of Gulf of Kachchh about 48 km away from Bhuj. It is a natural sheltered harbour in Kandla creek with average depth of 10 m. The port is equipped with all the modern facilities and state-of-the-art technology. The traffic handled at Kandla consists of crude oil, petroleum products, fertilizers, food grains, salt, cotton, cement, sugar, edible oils and scrap. Kandla has a capacity of handling a total traffic of 23.3 million tonnes. This port has been developed after independence to relieve congestion on Mumbai port. With the loss of Karachi to Pakistan as a result of partition of the country in 1947, the necessity of constructing a port on the Gujarat coast was keenly felt. Consequently this port was constructed in 1951.

This port has a vast hinterland covering large parts of Gujarat, Rajasthan, Haryana, Punjab, Delhi, Himachal Pradesh, Jammu and Kashmir and Uttarakhand. The port is well connected by roads and railways and has a bright future.

4. Marmagao. It is an important port of Goa located at the entrance of Zuvari estuary and occupies fifth position in handling the traffic. Its harbour is protected and holds about 50 steamers in fair season and 15 steamers in rainy season. It has the capacity to handle 16.1 million tonnes of cargo traffic. For a long period, it handled the export of iron-ore from Goa. Currently the major items of exports are iron ore, manganese, coconut and other nuts, cotton etc. Imports through this port are very few. It has a comparatively small hinterland covering the whole of

TABLE 26.18. Contribution of major ports

Name	Cargo Handled (2010) in 000 tonnes	Vassel Traffic (2009-110)	Container Traffic (2009-10) '000 TEUs ranges
Kandla	74,521	2,756	147
Vishakhapatnam	65,501	2,406	98
Chennai	61,057	2,131	1,216
Navi Mumbai	60,741	3,096	4,062
Mumbai	54,542	1,639	38
Paradeep	57,011	1,531	4
Marmagao	48,847	465	17
Kolkata	46,295	3,462	302
Mangalore	35,528	1,168	31
Tuticorin	23,787	1,414	440
Kochi	17,429	872	290
Ennore	10,713	273	—

Source : Indians Ports Association, 2012.

Goa and parts of north Karnataka coastal region and southern Maharashtra.

With the opening of the Konkan railway, the importance of this port has increased significantly and it is fast emerging as a multi-commodity port. Four new harbours are being constructed in the Vasco Bay for handling container traffic and general cargo.

5. New Mangalore. New Mangalore port was declared as the 4th Major port on 4th May, 1974 and was formerly inaugurated on 11th January 1975. This is an important port located at the southern tip of the Karnataka coast north of the Gurpur river. Initially it was designed for small ships. However, it was upgraded in the Fourth Five Year Plan to accommodate larger ships. A harbour was constructed so that business could be carried on throughout the year. Its hinterland lies in Karnataka and northern part of Kerala. Tea, coffee, rice, maize, wheat. cashew kernels, fish, rubber, oil products, iron ore pallets, granite etc. are exported through this port. The major items of import through this port are crude oil, coal, iron ore fines, LPG, limestone, wooden logs, cement, liquid chemicals, fertilizers, edible oils etc. Its main importance lies in export of iron ore from the Kudremukh mines. The port is well linked through broad gauge rail line and NH-17 with Mumbai and Kanniyakumari.

6. Kochi. It is another natural harbour on the west coast of India and is located on the coast of Kerala. Kochi has sheltered backwater bay. Located at Willlington island on the South-west coast of India about 930 km south of Mumbai and about 320 km north of Kanniyakumari. Kochi was given the status of Major Port in 1936. With its strategic location within the proximity of the international sea route between Europe in the west and the Far East and Australia in the east, it is capable of attracting a large number of container liners offering immense business opportunities. It handles the export of tea, coffee and spices and imports of mineral oil and chemical fertilizers. The Kochi Oil Refinery receives crude oil through this port. It is also a ship-building centre. Imports through this port far excel the exports. In fact, imports are about five times more than the exports.

The hinterland of this port includes the whole of Kerala and ports of Tamil Nadu and Karnataka. About 97 per cent of the total volume of traffic is accounted for by Kerala alone. The port is the natural gateway to the vast industrial and agricultural market of south-west India.

7. Kolkata. It is a riverine port located on the left bank of river Hugli about 128 kms inland from the Bay of Bengal. Kolkata port handles goods coming from South-East Asian countries, Australia and New Zealand. Kolkata port is called the 'Gateway to Eastern India.' It is the world's most important centre of jute industry. Kolkata is the main port for exporting jute products, tea, coal, steel, iron ore, copper, leather and leather products, textiles, manganese and many more items. The imports consist mainly of machinery, crude oil, paper, fertilizers and chemical products.

Kolkata port suffers from a number of problems. It is located on the bank of the River Hugli, which suffers from the problem of silting as tidal bores enter this port frequently. Sandy bars and islands have been formed at several places. The river is in its old stage and bends at several places creating lot of problems for the ships because they do not find a straight passage from the coast to the port. To sum up *Kolkata port has a serious problem of 'bends', 'bars' and 'bores'*. The depth of water is gradually declining. This has necessitated constant dredging so that larger vessels are able to enter the port. Expert pilots are required to conduct the ships and the cost of mainitaining the port has become prohibitive.

To rid the Kolkata port of some of the problems mentioned above, a barrage has been constructed across the Ganga at Farakka. This barrage is designed to divert water along the Bhagirathi-Hugli. However, with the signing of water treaty between India and Bangladesh, adequate water is not available in the Hugli river. Only a change in the treaty can improve the situation.

Steps have been taken for modernising and replacing port craft; strengthening of cargo handling equipment; better utilisation of dry docks and deap drafted areas and promotion of ship-breaking activities.

Kolkata port has a vast hinterland. Almost whole of the eastern and north-eastern parts of the country are included in the hinterland of this port. The main areas comprising the hinterland of Kolkata are West Bengal, Bihar, Jharkhand, Uttar Pradesh, Uttaranchal, Sikkim, Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya, Tripura and northern parts of Chhattisgarh and Madhya Pradesh. Two landlocked countries *viz*. Nepal and Bhutan are also parts hinterland of this port.

8. Haldia port has recently been developed on the confluence of rivers Hugli and Haldi about 105 km downstream from Kolkata. Its main purpose is to release congestion at Kolkata. It receives larger vessels which otherwise would have to go to Kolkata. Some of the large vessels which cannot enter the Kolkata port can easily come upto Haldia. Haldia has an oil refinery and a fertilizer factory. A large integrated petro-chemical plant has also been set up here. An important rail link connects Haldia with Kharagpur. The main items of trade are mineral oil and petroleum products. Haldia-Dock complex has plans to develop a berth on BOT basis. The hinterland of Haldia covers the same territories as that of Kolkata although to a much lesser extent.

The Bhagirathi river has changed its course recently as a result of which Haldia's future has become uncertain. With the large-scale deposition of silt near the port (Nayachar), the entry of large ships has become difficult.

9. Paradwip. It is a deep water (depth 12 metres) and all weather port located on the Odisha coast about 100 km east of Cuttuck. Because of its great depth, this port is capable of handling bulk carriers of over 60,000 DWT. Construction of an exclusive oil jetty to handle about 6 to 8 million tonnes of petroleum products and crude tankers of 85,000 DWT was completed recently. Constructed in the Second Five Year Plan period, this handles iron-ore and coal along with some other dry cargo. Large quantity of iron ore is exported to Japan through this port. The imports through port are only half of its exports. The hinterland of Paradwip port is comparatively small and covers Odisha only.

10. Vishakhapatnam. It is the deepest land-locked and protected port built at the coast of Andhra Pradesh. It was thrown open to commecial shiping on 7th October, 1933. Since then, this port has been consistently upgrading its infrastructure in tune with advancing technology. An outer harbour has been developed to handle the export of iron-ore. Elaborate arrangements have been made to handle crude oil and other petroleum products. It also handles fertilizers. Vishakhapatnam has a capacity of handling 16.7 million tonnes of cargo traffic. It also has the ship-building and ship-repair industry. The primary export items are iron ore (especially from Bailadila mines to Japan), manganese ore, spices and wood. The imports comprise mainly of mineral oil, coal, luxury items and other industrial products.

The hinterland of Vishakhapatnam port commands an approximate area of 3.4 lakh sq km which is constituted by Andhra Pradesh, Telangana and the contiguous parts of Chhattisgarh, Madhya Pradesh, Maharashtra and Karnataka. This part of the country is very rich in mineral resources and agricultural produce.

11. Chennai. Chennai is the oldest artificial harbour on the East Coast of India established in 1875. It does not possess a natural harbour and an artificial harbour has been created in an area of 80 hectares near the coast. It mainly handles petroleum products, fertilizers, iron-ore and general cargo. The major items of exports are rice, textiles, leather and leather goods, tobacco, coffee, manganese ore, fish and fish products, coconut, copra etc. The imports consist of coal, crude oil, paper, cotton, vehicles, fertilizers, machinery, chemical products etc. It has a capacity to handle a traffic of 21.37 million tonnes and can accommodate as many as 21 vessels inside the harbour. Chennai is often hit by cyclones in October and November and shipping becomes difficult during these months. It is ill-suited for large ships because of the lesser depth of water near the coast.

The hinterland of the Chennai port encompasses the large part of Tamil Nadu, southern part of Andhra Pradesh and some parts of Karnataka. The port is gaining importance due to increased significance of its hinterland.

12. Ennore. This port has recently been developed to reduce pressure of traffic on Chennai port. Located slightly in the north of Chennai on the Tamil Nadu coast, this is the country's first corporate port. It envisages construction of two coal berths, one iron ore berth, one LNG berth, two POL/liquid chemicals berths and one crude oil berth for handling very large crude carriers. It has also a perspective

plan to build three multi-purpose berths, five POL/liquid-chemicals berths and five container berths. The major items of traffic on the port are coal, iron ore, petroleum and its products, chemicals, etc. Its hinterland is a part of the hinterland of Chennai port.

13. Tuticorin. This port has also been recently developed at the Tamil Nadu coast about 8 km south-west of the old Tuticorin port. It has an artificial deep sea harbour which can accommodate vessels upto 8 metre draft in any season of the year. Two new berths are being developed. There is a plan to increase the depth of the port from the present 10.7 metres to 12.8 metres so that larger vessels could be accommodated. A long-term plan to build an outer harbour in four stages is also envisaged. The idea is to handle containers upto 6.3 million TEUs by 2021. The port handles the traffic of coal, salt, food grains, edible oils, sugar and petroleum products. Its main purpose is to carry on trade with Sri Lanka as it is very near to that country. Its hinterland is formed mainly by southern Tamil Nadu comprising districts of Madurai, Kanniyakumari, Ramnathpuram, Turunelveli and southern part of Tiruchchirappally. It is well connected by railways and roads.

Minor Ports. There are 200 minor ports, with a pronounced accent on the west coast. These ports are located in Gujarat, Maharashtra , Goa, Daman and Diu, Karnataka, Kerala, Lakshdweep, Tamil Nadu, Puducherry, Andhra Pradesh, Odisha, West Bengal and Andaman & Nicobar.

RAM SETU OR SETHUSAMUDRAM

Also known as Adam's Bridge, it is an ancient bridge which is made up of a 30 km long chain of shoals and sandbars between the southernmost island of Rameshwaram in Tamil Nadu State of India and Talaimannar of Sri Lanka. Two contradictory view points are being put forward regarding the origin and structure of this bridge. According to Hindu mythology, this bridge was built by Lord Rama to attack the Lankan king Ravana. Archaeological Survey of India (ASI) in its affidavit submitted to the Hon'ble Supreme Court of India said that the bridge is a natural formation made up of shoals and sand bars formed due to several millennia of wave action and sedimentation. Geological Survey of India (GSI) found that Ram Setu was not a man-made structure but represented a geological divide between the Palk Bay and the Gulf of Mannar. Several satellite images taken by NASA confirmed that Ram Setu was a 'tombolo' which is a narrow piece of land between an island or offshore rock and a mainland shore, or between two islands or offshore rocks. These are naturally occurring formations. Indian Space Research Organisation (ISRO) has opined that this is not a man-made structure, rather it has been formed by corals, sandbars and marine rocks.

The Plan. There is shallow sea between Dhanushkodi, the extreme end of Rameshwaram Island of India and Talaimannar of Sri Lanka with depth varying from 1 metre to 10 metres. Such a shallow stretch of sea is not suitable for shipping although ferry service was in operation till 1970s. The Government of India planned a sea water way 167 km long 300 metre wide and 62 metre deep by dredging a part of the sea level in this stretch of the shallow sea so as to provide a direct shipping route between Kanniyakumari and Tuticorin on one hand and other parts on the eastern coast of the country on the other hand. With the opening of this route, the ships don't have to move around Sri Lanka and save a lot of time and fuel. The original plan convisaged the movement of 3,055 ships by 2008 and 7,140 ships by 2025.

Historical Background. This plan was originally proposed by a British Commander A.D. Taylor of the Indian Marine in 1860. He felt that a navigation route could be created by dredging a part of Ram Setu. This route could be much shorter than the route around Sri Lanka and was able to serve the eastern coast of India in a much better way. In the year 1863, **Sir William Denison** selected a site about a mile (1.61 km) east from the one recognised by the Parliamentary Committee Report. However, the southern approach of the canal was left exposed to south-west monsoon and the proposal was declared unsuitable. In 1961, Townsend proposed the canal across Pamban Channel to enable passage of large vessels. However, the requirement of a curved channel subject to strong currents through Pamban Pass made it out of practical consideration. The Steering Committee Report of 1998 observed that on account of the declaration of the Gulf of Mannar as a biosphere reserve, a careful study would have be conducted with regard to implications of the project upon the said biosphere

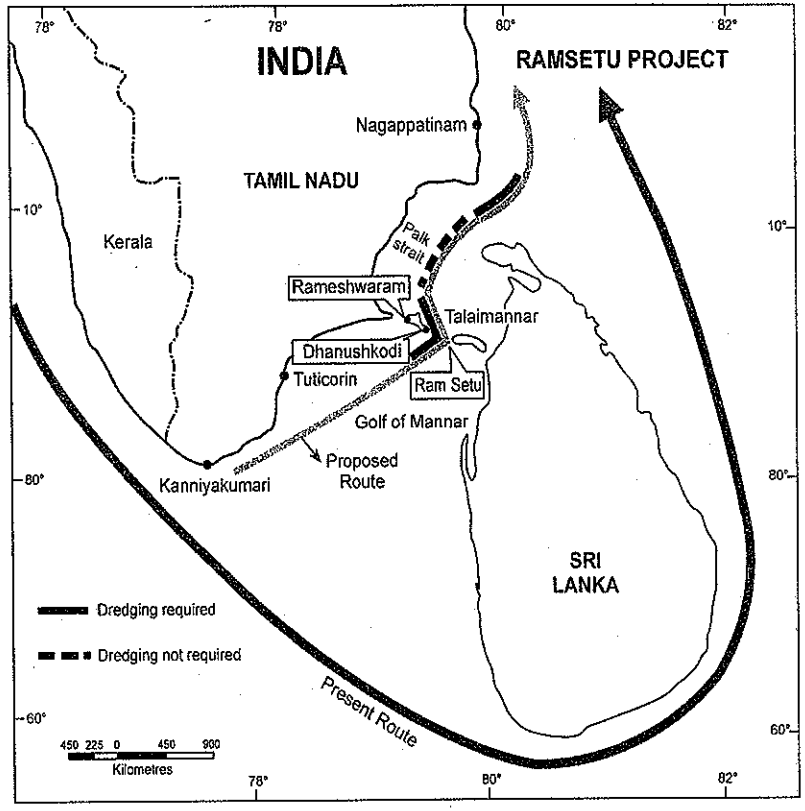

FIG. 26.10. The Ram Setu Project.

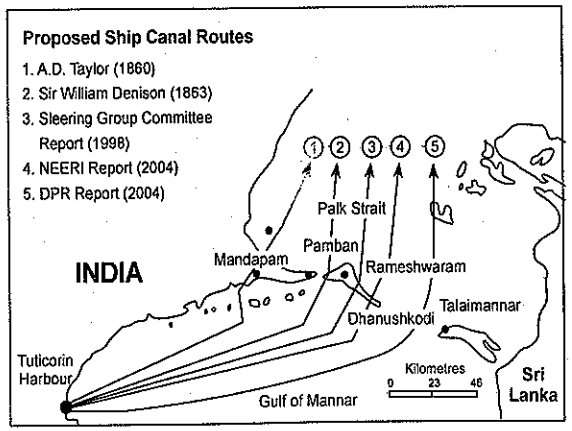

FIG. 26.11. Proposed Ship Canal Routes

reserve. It suggested another alignment of the canal, east of the island, can be thought afresh wherein land and could be avoided. The National Environmental Engineering Research Institute (NEERI), Nagpur, considered an Environmental Impact Assessment in 2004 and approved the alignment No. 6 as being environmentally viable route. In the same year DPR consultants validated NEERI's proposal with minor modifications in the entrance from the Gulf of Mannar after consideration of three different alternatives in the Ram Setu Bridge.

The Central Government under the leadership of the then Prime Minister Shri Atal Behari Vajpayee started this project in 1998 on the basis of the report of the Steering Committee and was formally inaugurated by Dr. Manmohan Singh in 2005. The dredging in the Adams Bridge region has been stopped in view of the Hon'ble Supreme Court Order dated 31st August, 2007 and 14th September, 2007. Pursuant to the orders of the Hon'ble Supreme Court, a Committee of Experts has been constituted under the Chairmanship of Dr. R.K. Pachauri, Director General, Energy and Resources Institute to consider the alternative alignment in respect of the Sethusamudram Ship Channel Project. Based on the recommendation of the Expert Committee, National Institute of Oceanography (NIO), Goa, has been assigned the task of undertaking Environment Impact Assessment (EIA) of the proposed alternative alignment. The NIO has submitted its report to the government for consideration. The future of this project will depend upon the reaction of the new BJP Government at the centre under the dynamic leadership of Shri Narendra Modi.

Controversies

This project has been surrounded by controversies since the day of its inception. There are strong arguments in favour of the project and still stronger arguments against it.

Arguments in favour of the project

1. If and when completed this project will help in saving a lot of time and fuel because the proposed route is much shorter than the existing route (**Table 26.19**).
2. Fifteen minor ports will be developed between Kanniyakumari and Chennai.
3. Increased ship traffic will lead to economic spin-offs, particularly in the backward districts of Ramnathapuram and Tuticorin.
4. Project touted as the catalyst for an economic boom in Tamil Nadu.

Arguments against the project

1. The project is expected to adversely affect 21 national marine parks and livelihood of lakhs of fisherman.
2. Dumping of sand in the Gulf of Mannar is said to be a long-term environmental hazard.
3. Strategically, experts feel that while Coast Guard and naval patrolling capability will go up, it may not necessarily translate into increased Indian dominance in the area.
4. High maintenance with round-the-year desilting expense, as the sea current through the Palk Stract and cyclones will constantly bring in huge loads of silt.
5. Some experts feel that Ram Setu offered an affective obstacle in the way of extremely devastating tsunami which occurred in the Indian Ocean on 26th December, 2004. This obstacle forced the tsunami take a course around the Sri Lankan Island and saved the Malabar coast of India from the fury of the tsunami. According to International Tsunami Society, the corals of this area acted as a protective shield for Kerala because most of energy of the tsunami was exhausted by the time it reached the Kerala coast.
6. Some prominent geologists opined that this area is the region of plate tectonics and is not suitable for navigation.
7. Ecologists believe that Ram Setu obstructs strong currents coming from the Bay of Bengal and protects the ecological balance.
8. Experts of navigation apprehend that Ram Setu Project can lead to any natural calamity. If a ship is entrapped in the area, there is no device to take it out and save it.

TABLE 26.19. Saving of distance through Sethusamundram Project (SSP) route in nautical miles

From	To	Mileage by present route	Mileage by SSP route	Distance saved
Kanniyakumari	Chennai	750	407	343
Kanniyakumari	Vishakapatnam	1,014	724	290
Kanniyakumari	Kolkata	1,357	1,103	254
Tuticorin	Chennai	769	345	424
Tuticorin	Vishakhapatnam	1,028	662	366
Tuticorin	Kolkata	1,371	1,041	330

COMPETITIVE AND COMPLEMENTARY CHARACTER OF MEANS OF TRANSPORTATION IN INDIA

In India, there are four major modes of transportation *viz.* road, rail, air and water transport. To this may be added pipeline transportation. Air transport is the fastest and the costliest whereas water transport is the slowest and the cheapest mode of transportation. They serve entirely different purposes and have practically no competition and complementarity. Pipeline transport is of recent origin and is restricted to specific corridors only. Moreover pipelines are useful for transporting liquids and gases only and have a unique character of their own. Thus the main issue of competitiveness and complementarity is with respect to road, railways and water transport system. The problem of competition arises in a situation when optimum utilization of one mode of transportation is discarded and some other mode of transportation is given priority. As against this a situation of complementarity arises when one mode of transportation helps the other mode in such a way that both are used to their maximum capacity. Roadways and railways are complementary at certain places and under certain conditions whereas they are competitive with each other at some other places and in some other conditions.

Complementary Role or Different Modes of Transport

Generally speaking, roadways are useful for short distances whereas railways are more suitable for long distances. Roadways play an important role in carrying agricultural produce from fields, minerals from mining areas and industrial products from factories to the railway yards. Usually, these items are carried by trucks from fields, mines, and factories to the railway yards over distances varying from 100 to 150 km. It is for the railways to carry these goods in the wagons over longer distances. After reaching the destination railway yard, the goods are again transferred from the rail wagons to the trucks which carry the goods to their ultimate destination. Thus road and railways play a complementary role for each other for short and long distances respectively.

Like freight, roads and railways play a complementary role for short and long distances with respect to passenger traffic also. Roadways are always given preference over railways for travelling over short distances. This is primarily due to flexibility possessed by the roadways. Vehicles can be stopped anywhere on the road-side. As against this, railways completely lack flexibility because railway trains stop at fixed stations only. India is par excellent, a country of villages and most villagers travel in buses to reach the nearest railway station and continue their journey to a distant railway station. After completing their rail journey they get down and board the buses to reach their ultimate destination.

It is because of the above mentioned complementary character of roadways and railways that the government has been laying more emphasis on construction of village roads. Pradhan Mantri Gram Sadak Yojna (PMGSY) was launched to provide single all-weater road connectivity to eligible unconnected habitations having a population of 500 persons and above in the plain areas and 250 persons and above in hill states, tribal areas, desert areas and Left-wing Extremist (LWE) affected districts. Under

the programme, upto January 2012, about 4.41 lakh km roads to benefit 1, 14,433 habitations had been cleared.

Normally, road transport is prefer for journey extending upto 200-250 km and railways are preferred for journey more than this distance. Much of the long distances journey by rail is performed at night because railway coaches are equipped with sleeper and toilet facilities. But people living in areas surrounding the metropolitan cities prefer to travel by rail because railways offer monthly, quarterly and half-yearly passes at concesional rates to commuters. But these commuters use road transport to reach the railway station from their place of residence. Thus rail and road transport play a complimentary role with respect to commuters also.

Rail transport is almost completely absent in the Himalayan region (Jammu and Kashmir, Himachal Pradesh, Uttarakhand and north-eastern states). Under such a situation, the passengers travel long distances through the hilly areas to reach the rail head terminals at the foothills to continue their further journey by railway transport. Kalka, Hishiarpur, Dehra Dun and Shiliguri are such a railway terminals. People of the north-eastern states are almost completely deprived of the railway transport service. They have to travel long distances by road before they can reach any railway terminal from where they can reach their destinations situated at longer distances.

The Government of India has prepared an ambitious plan to improve inland waterways along major rivers of the country. The inland water transport system had been playing a vital role for transporting passengers and goods in early stage of development. But they lost much of their importance to road and rail transport because they could not compete with respect to speed. With growing pressure on road and rail transport and with crumbling infrastructure, inland water transport stand fair chances of reviving their old lost glory. The Government of India has already declared parts of five major river courses as national waterways. They are expected to play an important complementary role for both rail and road transport and relieve these modes of transport of much burden in the near future, particularly with respect to transportation of heavy and bulky commodities with low specific value. This is because water transport for heavy and bulky commodities is always much cheaper than roads and railways.

Roadway and railways play a major complimentary role to water ways with respect to international trade. The whole material for export is transported from the distant inner parts of the country to the ports by roads or railways to the ports from where it is exported to various countries by water transport. Similarly, imported goods imported through water transport are carried by roads and railways from the ports to different parts of the country. This is how ports develop their hinterlands. When the British rulers planned the development of rail routes in India, they paid due consideration to complimentary that existed between ocean routes and railway routes. This is the reason that all major railway lines were constructed to serve the major ports of India such as Mumbai, Kolkata and Chennai. The purpose was to carry raw materials from different parts of India to ports by roads and railways and then to Britain and finished industrial goods from Britain to ports and then to different parts of the country by roads and railways.

Competitive Role of Different Modes of Transport. The Government of India introduced scheme of grouping national permit to road transporters as a result of which trucks and buses started covering long distances across the inter-state borers. This initiated the period of competition between road and railways. Road transport is now more preferred upto a distance of 250 km and there is a tough competition between roads and railways within this limit of the distance covered. But railways are still preferred for distances exceeding 400-500 kilometres. Whereas railways offer more flexibility, over short distances, railways provide more comforts over long distances.

A casual look at the rail and road map of India reveals that in most parts of the country, railways and roadways run parallel to each other. This further adds to competition between these two modes of transportation as passengers and goods are divided between the two. Several surveys have indicated that railways are fast losing to roadways, particularly with respect to short distances upto about 250 km. For example most passengers from Delhi prefer to travel by road if they have to go to Chandigarh, Jaipur, Agra, Dehra Dun, Hardwar and *vice versa*. Similarly

traders prefer their goods to be carried by trucks between Delhi and these destinations because trucks can provide door to door service.

However, railways have an edge over roadways with respect to travel to some places of tourist interest. For example tourists prefer rail travel over road travel from Kalka to Shimla from Shiliguri to Darjeeling and from Pathankot to Kangra although buses and taxies take much less travel time between these stations. This is because of the fact that railway routes follow maundering path through the hilly areas and offer attractive spots of natural beauty which almost mesmerizes the tourists. A similar competition is found between railways and roadways for reaching Ooty in Tamil Nadu.

Even water transport offers tough competition to other modes of transportation in certain parts of India. **Figure 26.12** shows road transport is cheaper for short distances, railway transport is cheaper for long distances and water transport is cheaper for very long distances. Any mode of transportation aims at recovering the initial cost as well as moving or recurring cost from the passengers or goods transported by it. The road transport involves much less initial cost but the moving cost is very high. Therefore, road transport is the cheapest for short distance upto point A, beyond which rail transport is the cheapest upto point B. This is due to the fact that the initial cost in case is railways is much higher than that involved in railways, but moving cost for railways is much lower than for roadways. Initial cost in case of water transport is extremely high because huge amount of money is required for building ships, boats, steamers, ports and harbours. But moving cost is minimum in case of water transport because no expenditure is involved in maintaining water ways as against expenses for maintaining roads and railways tracks. Thus water transport is the cheapest for distances beyond point B.

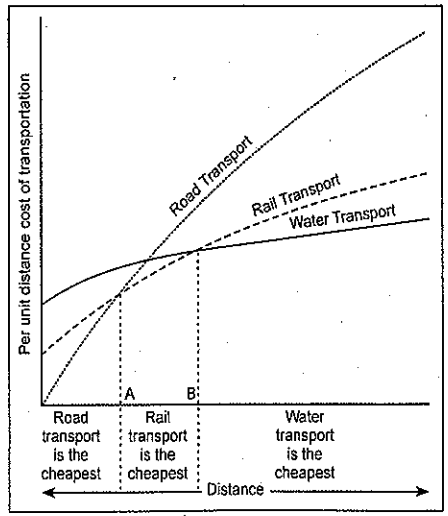

FIG. 26.12. Competition between road, rail and water transport

Industries tend to be located in those areas where cost of transport is minimum. This is known as ***'Principle of Least Cost of Transport'***. This principle is not applicable to India because inland water transport is not properly developed here. However, some cases of competition between road and water transport can be found in some parts of the country. For example, there is tough competition between road and water transport in the Ganga-Brahmaputra delta region with respect to transportation of jute because most of the jute mills are located along the banks of the Hugli river. Similarly, lakes, lagoons and backwaters in the coastal region of Kerala have been joined with one another by canals which provide excellent facilities of inland water transport. These water ways offer stiff competition to road transport in this region.

COMMUNICATION

Communication is different from transport. Whereas transport involves the physical carriage of passengers and goods from one place to another, communication only involves transmission of word message and ideas. In early days the only way a message could be conveyed was by word of mouth. The use of words as a means of passing on messages relied on the proximity of the giver and receiver of the message, but in order to extend the range over which information could be transmitted, signal systems of various kinds were developed. The main signals through which messages were conveyed included drums, smoke signals or fly signals. The invention of writing helped in preserving the messages and communication became dependent upon transport. Written messages and letters could be carried by hand, by animals, by boat and later by rail or motor

vehicles. In this way development of transportation had a deep impact on communications. But the technological advancements since the early nineteenth century helped in making communications independent of transport. Telecommunication (telegraph, telephone, radio, television, satellite, computer) are independent of transport network. But postal services still defend upon transport network.

Communication system contributes to the development of the economy, social relationships and also helps in promoting cultural unity. Internationally, it brings diverse people of the world close to one another.

In the event of any impending calamity, accident or emergency, instant means of communication flash the news across the globe so that relief can be rushed to the spot immediately.

Communication is of two types *viz.* 1. personal communication and 2. mass communication. Personal communication takes place between individuals and is made through postal network, telecom (telephone, telegraph, telex etc.) supported by computers. Mass communication, on the other hand, involves communication with the masses. Radio, television, cinema, press and print media and satellites are the main media of mass communication.

Personal Communication

Following are the chief modes of personal communication.

POSTAL SERVICES

It is the most commonly used mode of communication in India, the potal services play a vital role in the rural areas of the country.

The early postal system of India was solely used for official purposes and it was not until 1837 that the postal services were opened to the public. The first postage stamp was issued in Karachi in 1852, valid only in Sind province. In 1854, the Indian Post Office was reorganised as an institution, with a Director General-in-charge. 700 post offices were then already in existence. Since then, postal services have grown both in terms of the extent of the postal network and its scope and the variety of the services it offers. The statute governing the postal services in the country is the Indian Post Office Act, 1898. It vests the Government with the exclusive privilege of collecting, carrying and delivering letters within the country.

Indian Postal network is the largest postal network in the world. As on 31st March, 2011 country had 1,54,866 post offices, out of which, 1,39,040 were in rural areas and 15,826 were in urban areas. At the time of Independence there were 23,344 post offices throughout the country. Of these 19,184 post offices were in the rural areas and 4,160 offices in urban areas. The postal network has grown over six folds since then.

Expansion of postal network especially in the rural areas has been brought about by the system of extra departmental post offices. On an average, a post office serves an area of 21.23 sq km and a population of 7,817. Post offices in rural areas are opened subject to satisfaction of norms regarding population, income and distance laid down by the Department for the purpose. The element of subsidy involved in opening of post offices in hilly, desert and inaccessible areas is to the extent of 85 per cent of the cost, whereas the subsidy in opening of post office in normal rural areas, is to the extent $66\frac{2}{3}$ per cent of the cost.

The postal network consists of four categories of post office, *viz.*, head post offices, sub-post offices, extra-departmental sub-post offices and extra-departmental branch post offices. All categories of post offices offer similar postal services, delivery function being restricted to only earmarked offices. In terms of management control, accounts are consolidated progressively from branch post office to sub-post office and finally in head post office.

MAIL SYSTEM

First-class mail, *viz.*, post cards, inland letter cards and envelopes, are given air lift, without any surcharge, between stations connected by air. Second-class mail, *viz.*, book packets, registered newspapers and periodicals are carried by surface transport, *i.e.*, trains, buses and other means.

(*i*) (Postal Index Number) PIN has facilitated the prompt delivery of mail (*ii*) Speed post service has been introduced for fast and quick delivery of post (*iii*) Quick Mail Service (QMS) is another step in this direction.

MODERNISATION OF MAIL TRANSMISSION AND PROCESSING

Satellite Network

One hundred and fifty High Speed Very Small Aperture Terminals (VSAT) are being added to the existing 77 systems. With this the private network would consist of 227 VSAT stations and 1,350 Extended Stations. With the addition of 400 offices with capability to link to VSAT stations 1,977 post offices would be linked through this VSAT network to handle money orders and other related financial transactions.

Automatic Mail Processing Centres

Kolkata and Delhi have been put on the map of Automatic Mail Processing Centres with the induction of state-of-the-art letter-sorting machines. These two and the existing centres at Chennai and Mumbai would have additional equipment to cull, face and cancel the mail automatically.

Computerisation and Networking of Post Office

By the end of March 2007, the Department of Posts supplied computer and its peripherals like scanner, weighing scale, modems, etc. to all Head Post Offices and a large number of sub post offices.

Telecommunication

It is the modern device for the communication at individual and mass level. Telegraph, Telephone, Talex and Fax are the main means of telecommunication. The rise of telecommunication is directly linked with the advancement of electrical technology. Telecommunications brought about a revolution in communication system because of the high speed with which messages could be communicated. It became possible to send messages within a couple of minutes with the help of telegraphs which earlier took weaks together to reach their destinations. Further improvements made it possible to receive messages instaneously. People on opposite sides of the globe can speak to each other directly with the help of telephone, radio, television, Fax, internet etc. have facilitated the communication of messages within the time. Telecommunication services were introduced in India soon after invention of telegraphy and telephone.

1. Telegraph. The first development in telecommunications was the invention of the telegraph by Samuel Morse in 1844. Messages could be transmitted by wires as a series of electrical impulses. These signals formed the *Morse Code*, which could be readily interpretted. Telegraph wires soon linked most places and undersea cables were laid across seas and oceans and most places of the world were provided with telegraph links within a few decades.

First Telegraph line between Kolkata and Diamond Harbour was opened for traffic in 1851 just after seven years of invention. By March 1884, telegraph messages could be sent from Agra to Kolkata. By 1900, telegraph had started serving Indian Railways. Telegraph has now become outdated with the development of telephones, internet, e-mail etc. In fact it is completely closed down in India now.

2. Telephone. Telephone was invented by Alexander Graham Bell in 1875. The invention of telephone made possible direct and instantaneous links from one part of the world to another. A close network of telephone wires and undersea cables was laid to provide facility of telephonic links in different parts of the world.

As in the case of telegraph, telephone service was also introduced in Kolkata in 1881-82, barely six years after invention of telephone. First automatic exchange was commissioned at Shimla in 1913-14 with a capacity of 700 lines.

The Department of Telecommunication (DoT) has improved significantly since independence both in quality and quantity. Initially, the exchanges were of manual type, which subsequently were upgraded into automatic electro-mechanical type. In the last two decades, a significant qualitative improvement has been brought about by inducting Digital Electronic Exchanges in the network on a large scale. Today 100 per cent telphone exchanges in the country are of electronic type.

In the field of international communications, tremendous progress was made by the use of Satellite Communication and Submarine links. The voice and non-voice telecom services, which include data transmission, facsimile, mobile radio paging and leased line services, cater to a variety of needs of both residential and business customers. ISDN facility is

available in a number of cities. A dedicated Packet Switched Public Data Newtwork with international access for computer communication services is also made available.

The telecom sector has been one of the fastest growing sectors in recent years. It is now the second largest telephone network in the world, after only China. A series of reform measures by the government, wireless technology, and active participation by the private sector played an important role in the exponential growth of the telecom sector in the country. Tele-density, which shows the number of telephones per 100 persons, was 75.23 per cent in 2014. With the growth of mobile telephony due to easy access and affordability, the number of landline telephones has declined from 36.96 million in 2010 to 32.17 in million as on 31st October 2012. Wireless telephones now account for 96.7 per cent of all telephones. The share of the private sector, in terms of number of subscribers, has increased from 86.3 per cent to 86.6 per cent during the period from April to June 2012 and is currently placed at 86.1 per cent (end- October 2012).

Since the announcement of the Broadband Policy in 2004, several measures have been taken to promote broadband penetration in the country. As a result, there were 22.86 million internet subscribers including 13.79 million broadband subscribers at the end of March 2012. Broadband subscribers increased to 14.81 million by the end of October 2012. Special efforts are being made to increase the penetration of broadband, especially in rural and remote areas. The government has approved a project at a cost of ₹ 20,000 crore for creating a National Optical Fiber Network (NOFN) which will provide broadband connectivity to 2 5 lakh gram panchayats for various applications like e-health, e-education, and e-governance. The project is being funded under the Universal Service Obligation Fund (USOF).

Mass Communication

In a country of vest dimensions like India, mass communication plays a vital role in creating awareness among the masses, providing information and education as well as healthy entertainment. Electronic media (radio and television) and print media (newspapers and periodicals) are the main components of mass communication.

TABLE 26.20. Telephone Connections & Tele-density

	At the end of March (in million)				
	2010	2011	2012	2013	2014
Total telephones	621.28	846.33	951.35	898.02	933.02
Landline telephones	36.96	34.73	32.17	—	—
Wireless telephones	584.32	811.60	919.17	—	—
Rural telephones	200.77	282.29	330.83	—	—
Urban telephones	420.51	564.04	620.52	—	—
Telephones of Private Sector (% share)	515.41	720.32	821.08	—	—
	(82.96%)	(85.11%)	(86.31%)	—	—
Telephones of Public Sector (% share)	105.87	126.01	130.27	—	—
	(17.04%)	(14.89%)	(13.69%)	—	—
Rural tele-density in %	24.31	33.83	39.26	41.05	44.01
Urban tele-density in %	119.45	156.93	169.17	146.64	145.46
Overall tele-density in %	52.74	70.89	78.66	73.32	175.23

Source : Department of Telecom (DOT). Quoted in Economic Survey 2012-13, p. 246 and Economic Survey 2013-14, p. 204.

NATIONAL TELECOME POLICY (2012)

The Government approved National Telecom Policy (NTP) 2012, which addresses the vision, strategic direction, and the various medium- and long-term issues related to the telecom sector, on 31 May 2012. NTP-2012 is aimed at maximizing public good by making affordable, reliable, and secure telecommunication and broadband services available across the country. The objectives of NTP-2012 include the following :

- Provide secure, affordable, and high-quality telecommunication services to all citizens.
- Strive to create One Nation-One Licence across services and service areas.
- Achieve One Nation-Full Mobile Number Portability and work towards One Nation-Free Roaming.
- Increase rural tele-density from the current level of around 39 to 70 by the year 2017 and 100 by the year 2020.
- Recognize telecom, including broadband connectivity, as a basic necessity like education and health and work towards 'Right to Broadband'.
- Provide affordable and reliable broadband-on-demand by the year 2015 and to achieve 175 million broadband connections by the year 2017 and 600 million by the year 2020 at minimum 2 Mbps download speed and make available higher speeds of at least 100 Mbps on demand.
- Provide high-speed and high-quality broadband access to all village panchayats through a combination of technologies by the year 2014 and progressively to all villages and habitations by 2020.
- Recognize telecom as an infrastructure sector to realize the true potential of information communication technology (ICT) for development
- Address right-of-way (RoW) issues in setting up of telecom infrastructure.
- Mandate an ecosystem for ensuring setting up of a common platform for interconnection of various networks for providing non-exclusive and non-discriminatory access.
- Strive for enhanced and continued adoption of green policy in telecom and incentivize use of renewable resources for sustainability.
- Achieve substantial transition to the new Internet Protocol (IPv 6) in the country in a phased and time-bound manner by 2020 and encourage an ecosystem for provision of a significantly large bouquet of services on the IP platform.

Prasar Bharati

Prasar Bharati is the public service broadcaster in the country, with All India Radio and Doordarshan as its two constituents. It was constituted on 23 November, 1997. The major objectives of the Prashar Bharati are :

(*i*) Upholding the unity and integrity of the country and the values enshrined in the constitution.

(*ii*) Promoting national integration.

(*iii*) Safeguarding citizen's rights to be informed on all matters of public interest and presenting a fair and balanced flow of information.

(*iv*) Paying special attention to the fields of education and spread of literacy, agriculture, rural development, health and family welfare and science and technology.

(*v*) Creating awareness about women's issues and other vulnerable sections of the society.

(*vi*) Providing adequate coverage to the diverse cultures, sports and games and youth affairs.

(*vii*) Promoting social justice, safeguarding rights of working classes, minorities and tribal communities.

(*viii*) Expanding broadcasting facilities and promoting research and development in broadcast technology.

Radio

Radio is a powerful medium which provides all sorts of useful information, news and variety of entertainment. Radio broadcasting began in India in early 1920's. The first programme was broadcast in 1923 by Radio Club of Bombay. This was followed by setting up of a Broadcasting Service in 1927 on experimental basis in Bombay (Mumbai) and Calcutta (Kolkata). The Government took over the transmitters and began operating them under the name Indian Broadcasting Service. It was changed to All India Radio (AIR) in 1936.

At the time of independence *i.e.* in 1947. AIR had a small network of six stations and 18 transmitters. The coverage was 2.5 per cent of the area and 11 per cent of the population. Today AIR has a network of 225 broadcasting centres covering 91.42 per cent of the area almost reaching the entire population. Operating in a linguestically diverse country like India, AIR broadcasts in 24 languages and 146 dialects.

AIR operates its services through five channels namely : (*i*) Primary Channel, (*ii*) National Channel, (*iii*) Commercial Broadcasting Service (Vividh Bharti), (*iv*) FM Channels and (*v*) External Services Channels.

There has been a phenomenal progress in the news broadcasting by AIR. From 27 news bulletins in 1939-40. AIR now puts out 346 bulletins daily. News Headlines for every hour are broadcast on AIR FM, Delhi, AIR News on Phone was introduced in 1998.

Doordarshan

Doordarshan (DD), the national television service of India is one of the largest terrestrial networks in the world. Television broadcasting assumes tremendous importance in a developing country like India, which has low literacy rate and has varied cultures and multiple languages. Today, television is the most efficient and effective way to disseminate information and educate the masses. The country today has both terrestrial and satellite broadcasting services.

The first telecast in India orginated from a makeshift studio in the Akaswani Bhawan, New Delhi on 15 September, 1959. The regular service with a news bulletin became operational in 1965. After seven years, the second television commenced service in Mumbai, By 1975, TV service was available in Kolkata, Chennai, Srinagar, Amritsar and Lucknow.

The first experiment with satellite technology in India was conducted in 1975-76 under the programme Satellite Instructional Television Experiment (SITE). This was incidently, the first attempt in the world to use satellite broadcasting for social education. Colour transmission was introduced during the Asian Games held in New Delhi in 1982. The year 1982 also witnessed the introduction of a regular satellite link between Delhi and other transmitters, heralding the arrival of the National Network. Metro Channel was introduced in 1984.

Doordarshan presently operates 30 channels. It has three-tier programme service—National, Regional and Local. The National programmes are concerned with events and issues of the entire nation. The regional programmes cater to the interests of a particular state or region. The local programmes are area specific and cover local issues featuring local people. A new entertainment channel of Doordarshan, DD Bharati was launched on 26 January, 2002.

The programmes telecast by Doordarshan include news, current affairs, science, cultural magazines, documentaries, music dance, drama, serials and feature films. Government policies, development programmes and current affairs are regularly telecast. It also transmits educational programmes for schools and universities. There are different channels for different types of programmes.

Several channels on television have been made available to provide entrepreneurs. This has promoted a keen and healthy competition to improve the quality of programmes. At present programmes of all types can be viewed at all the twenty-four hours of the day.

Cinema

Cinema is yet another power means of mass communication. It entertains millions of people everyday throughout the country. Feature films are being produced in India since 1912-13. The initial productions consisted of silent films. The era of silent films was overtaken by the talkie era in 1931 when Ardeshir Irani (1886-1969) produced *Alam Ara*. India now leads the world in the annual output of feature films. Before the advent of the TV era, cinema was the main source of entertainment for the masses but lost much of its viewership to TV. However, it has once again captured its viewers and regained the lost glory. In India, films can be publically exhibited only after they have been certified by the Central Board of Film Certification (CBFC).

Press and Print Media

Newspapers, periodicals and journals fall in the category of print media. According to the report of the Press Registrar, the total number of newspapers and periodicals being published in India was 65,032 in 2007. There were 7,131 dailies, 374 tri/triweeklies, 22,116 weeklies, 8,547 fortnighlies, 19,456 monthlies, 4,470 Quarterlies, 605 Annuals and 2,333 other periodicilies. Newspapers were published in as many as 123 languages and dialects during 2007. The largest number of newspapers (20,589) were published in Hindi followed by English (7,596) and Marathi (2,943). Daily newspapers were brought out in all the principal languages except Kashmiri.

Newspapers were published from all states and union territories. During 2007, the largest number of newspapers were published from Uttar Pradesh (8,397) followed by Delhi (6,926), Maharashtra (6,018) and Madhya Pradesh (3,555). Uttar pradesh continued to have the largest number of daily newspapers (841), followed by Maharashtra (573), and Karnataka (479). Bombay Samachar, a Gujarati daily published from Mumbai since 1822 is the oldest existing newspaper.

Computers

"Computer is an electronic device which is used for electronic data processing. It accepts the data, processes the data and converts the data into meaningful information. It is also used to perform mathematical and logical operations." This simple definition of computer amply proves that computers have a wide range of uses and play a dominant role in the sphere of communication system. Basically, a computer performs the following four functions :

(*i*) It accepts data as input.

(*ii*) It stores data, keeps it in its memory, and recalls the same as and when required.

(*iii*) It processes data as per instructions given to get required information.

(*iv*) It communicates the information as output.

The versatile use of computers in so many different fields is the outcome of its special capabilities in terms of speed, accuracy, consistency, storage capacity and automation. It plays an important role in the fields of education and transfer of knowledge by dint of its aforesaid qualities.

INDIAN SPACE PROGRAMME

India's space ventures date back to the ancient times when fireworks based on Chinese technology were first used in the country. Use of rockets by the Indians during the Mysore war against the British rulers inspired William Congreve to come out with Congreve rocket in 1804. Indian scientists and politicians recognised the significance of rocket technology and steps were taken immediately after Independence to develop this branch of science for defence, and for research and development in other fields. A young Indian British Veteran Sarabai (1919-1971) founded a research laboratory for the study of cosmic rays. Another distinguished scientist, Homi Bhabha (1909-1966), also studied cosmic rays in 1940s. He realised the potential of satellite and Indian National Committee for Space Research was formed in 1962. The purpose of this committee was to identify the country's goals and priorities in the field of space research. Thumba near Thiruvananthapuram was chosen as an international facility for launching sound rockets and it became operational in 1963 for launching foreign rockets to study atmosphere. The main reason for selecting Thumba was its proximity to the magnetic equator of the earth.

The Indian Space Research Organisation (ISRO) prepared a programme to make sounding rockets and their propellants at Thumba. A Space Science and Technology Centre was also set-up at Thumba. Thumba Complex was renamed as Vikram Sarabai Space Centre in honour of Sarabhai who made an outstanding contribution to the development of space science and technology in India.

The island of Sriharikota in Andhra Pradesh about 80 km north of Chennai, was chosen as a launch centre and it became operational in 1971 when Rohini-125, a sounding rocket was launched from here. Sriharikota has been renamed as Satish Dhawan Space Centre in honour of the late Prof. Dhawan who played a key role in realising the dream of Sarabhai. This centre has several tracking radars, including a Doppler Weather Radar (DWR) for detecting wind velocity in real time and for understanding severe weather conditions. Meanwhile, a space centre as set-up at Ahmedabad in 1967 to provide the necessary thrust for application of space technology in different fields of development. A satellite project as also established at Bengaluru in 1972 which was developed as ISRO Satellite Centre later on. This centre has the provision for design, development and launching of all spacecraft. Centres have also been established at Balasore in Odisha, Lucknow in U.P., Car Nicobar in Andaman and Nicobar Islands, Kavalur in Tamil Nadu.

Rohini-75. Rohini-75 (the number indicating the diameter of the rocket in millimetres) was the first successful rocket launched from Thumba in 1967. This was followed by Rohini-100; 125, 300 and 560. The main purpose of these rockets was to study the atmosphere and conduct tests for sub-systems for

bigger launch vehicles. The success in sounding rockets led to the design and development of a Satellite Launch Vehicle (SLV). Till now over 1,000 sounding rockets have been launched. To begin with, only a single stage rocket weighing 100 kg. was launched and later on a stage of four stage rockets weighing 17,000 was reached.

Satellite Launch Vehicle (SLV) and Augmented Satellite Launch Vehicle (ASLV). The first SLV-3 was launched from Sriharikota in August 1979 which infinitely proved a failure. The second attempt was made by launching is 35 kg Rohini satellite in July, 1980 which was orbited by SLV3. This attempt was a successful after which many successful attempts were made from 1981 to 1983.

ISRO started working on an ASLV which was designed to put a 150 kg satellite into near earth orbit. The attempts made in this regard in 1987 and 1988. could not meet much success. ASLV-D2 was launched in July 1988. In spite of many improvements, this attempt failed. Further improvements were made in ASLV-D3 and its launch in May, 1992 was successful. The object of this mission was to operationalise the ASLV's capability of placing a 150 kg satellite—as a part of ISRO's Stretched Rohini. Satellite Series (SROSS)—into a 400 km near circular orbit. This could achieve only partial success.

Geosynchronous Satellite Launch Vehicle (GSLV) is a three-stage vehicle for the launch of which attempt was made in March 2001. It developed some technical problems which were removed at a later stage. The successful launch took place on 19 April, 2001. The second development flight of GSLV with GSAT-2 onboard weighing 1,825 kg was launched successfully in 2003. The rocket placed the geosynchronous satellite, EDUSAT, in correct orbit in September, 2004. The launch of GSLV-FO2 in July, 2006 was a complete failure as it crashed in the Bay of Bengal about 60 seconds after the take off.

APPLE (Ariane Passenger Payload Experiment) was launched from Kourou in French Guyana on 19 June, 1981. Its life was designed for two years but it worked for 27 months. It helped in conducting a number of experiments including those concerned with communication, TV, computer, etc.

INSAT (Indian National Satellite System) series. In 1980, the Government of India decided to purchase typical type of satellites which could help simultaneously in the fields of communication, TV and meteorology. The first in this series was INSAT-1 which had a capacity to provide 4,300 two-way telephone circuits through 12 transponders for national coverage. Transponders are devices which receive radio signals from the ground and transmit them. INSAT-1A launched on 10 April, 1982 from Cape Canaveral could not meet the desired goal due to a number of technical problems. INSAT-1B was an improved version and was launched from a US space shuttle in September 1983. It functioned well for over seven years, a duration which was longer than its designed life. INSAT-1C was launched in July, 1988 by an Ariane rocket. It met with only half success because it helped in operating only half the communication and television channels but the meteorological package worked fully. On 22 November, 1989, the spacecraft lost its contact with the earth. INSAT-1D was launched in June, 1990. All services of INSAT-1B were transferred to INSAT-1D.

Although India depended heavily on the imports for the first generation of INSATs, the second generation of this series was indigenously developed and fabricated, INSAT-2A was launched on 2 July, 1992. This was followed by launch of INSAT-2B on 22 July, 1993. These two missions were successful to a great extent and provided increased capacity for telecommunications and broadcasting, better resolution for weather forecasting, etc.

INSAT-2C and INSAT-2D were designed without monitoring payload because there was sufficient facility for this purpose in the satellites which were working in 1995. These two satellites could not live their full life due to short circuit. INSAT-2E was an improved version of the earlier satellites. It was launched from Kourou in April, 1999. Its transponders were able to cover vast parts of South-east Asia, China, Europe and Australia. It was supposed to work for 12 years. The commissioning of INTELSAT-2E has strengthened the telecom services, TV broadcasting and it also carries an advanced meteorological payload.

The third generation of INSAT series started with the launch of INSAT-3B in March, 2000 from Kourou. It was a communication satellite launched ahead on INSAT-3A following the failure of INSAT-2D. This was followed by INSAT-2C in 2002 and INSAT-3A and 2003.

INSAT-4 series was started in December 2005 from Kourou. It has been used for direct to home television within the country and for communication within India as well as in countries located in south-east and north-west of India.

EDUSAT. Satellite links have become a strong tool in the field of education keeping in view the acute shortage of competent teachers at the school, college and university level as well as in the professional institutions. EDUSAT was launched by ISRO in 2004 to provide easy access to quality education. In addition to providing support to formal education, it is used for propagating information regarding health, hygiene etc. among the rural masses and in remote areas. *Telemedicine through INSAT* has also become a reality and lakhs of people are benefited by this project.

Remote Sensing Satellites

Keeping in view the growing importance of Remote Sensing in everyday life, ISRO prepared a programme to launch remote sensing satellites in 1979 and consequently Bhaskara-I and Bhaskara-II were launched. Bhaskara-I was used to study agricultural land, dry deciduous forests within the tropics, dry temperate forests of the Himalayas and ice cover in the Himalayan region. Bhaskara-II was used to study, land, ice cover, drought prone areas, geological structure and forest resources. Maps concerning land cover and land use were prepared for West Bengal and Bihar. Images of sedimentary cover over the Ganga plain were obtained. Maps of forest cover for Karnataka, West Bengal, Odisha and Kachchh were prepared. Besides, ice cover over parts of the Himalayas were also studied. Satellite Launch Vehicle (SLV)-3 was launched in April 1983 which helped in studying water and forest resources cloud and ice cover.

September 9, 2012 was the historic day with ISRO when it launched 100th mission Polar Satellite Launch Vehicle (PSLV-C21) from Sriharikota.

In the year 1972, National Remote Sensing Agency (NRSA) was set-up at Balanagar near Hyderabad. First remote sensing satellite known as Indian Remote Sensing Satellite (IRS-IA) was launched on 17th March, 1988. It was equipped with Linear Imaging Self Scanning Sensors (LISS) which help in giving better results.

The second generation **IRS-1C** remote sensing satellite was launched in 1995 which completed its ten year tenure in 2005. During those ten years it took over 6 lakh images while revolving around the earth for 60,000 times. **IRS-P3** was launched in 1995 for studying ice, clouds, moisture in crops and damages caused by floods. **IRS-1D** was launched in 1997 which took images of U.S.A., Germany, Japan, Dubai, Korea and Thailand in addition to those of India.

Oceansat was India's first satellite which aimed at studying fish resources, change in sea level, speed of sedimentation, sea pollution, sea water temperature, air moisture over the sea surface and coral reefs. It was launched in 1999.

Technology Experiment Satellite (TES) was launched in 2001. It aimed at possibilities of introducing new technology in cartography.

Resource Set-I was an improved version of IRS-1C and IRS-1D and was meant to estimate the natural resources in the country. It was launched in 2003.

Cartosat-1 and Cartosat-2 were launched in 2005 and 2007 respectively. They are designed to up date topographical maps and prepare maps on large scale of 1 : 50,000. Maps prepared in this way are in great demand all over the world due to their accuracy and high quality. Normally, these satellites prepare maps for about 30 km in one day and complete map of the whole country within 100 days. At this speed, they can prepare a map for the whole world within one year.

Polar Satellite Launch Vehicle (PSLV) uses both gas and liquid fuel. **PSLV-D1 mission** was launched on 20 December 1993 from Sriharikota. It could not succeed much due to fault in its software. PSLV-D2 mission was launched on 15 October, 1994 again from Sriharikota. Third launch of PSLV was conducted in 1996. In the year 1997, PSLV-C1 launched IRS-1D. In the year 1999, PSLV-C2 or Oceansal was launched.

Chandrayan-1 Mission

Chandrayan which in Sanskrit means 'Moon Vehicle was the most ambitious and most talked about space project which thundered off into the space on 22 October, 2008 from Satish Dhawan Space Centre located in Sriharikota by means of the four stage space workhorse PSLV (Polar Satellite Launch Vehicle) featuring alternate liquid and solid fuel stages. It started revolving around the earth on an elliptical path being 240 km away in **parigee** and 24,000 km away in **apogee**. It started moving towards the moon after making a number of revolutions

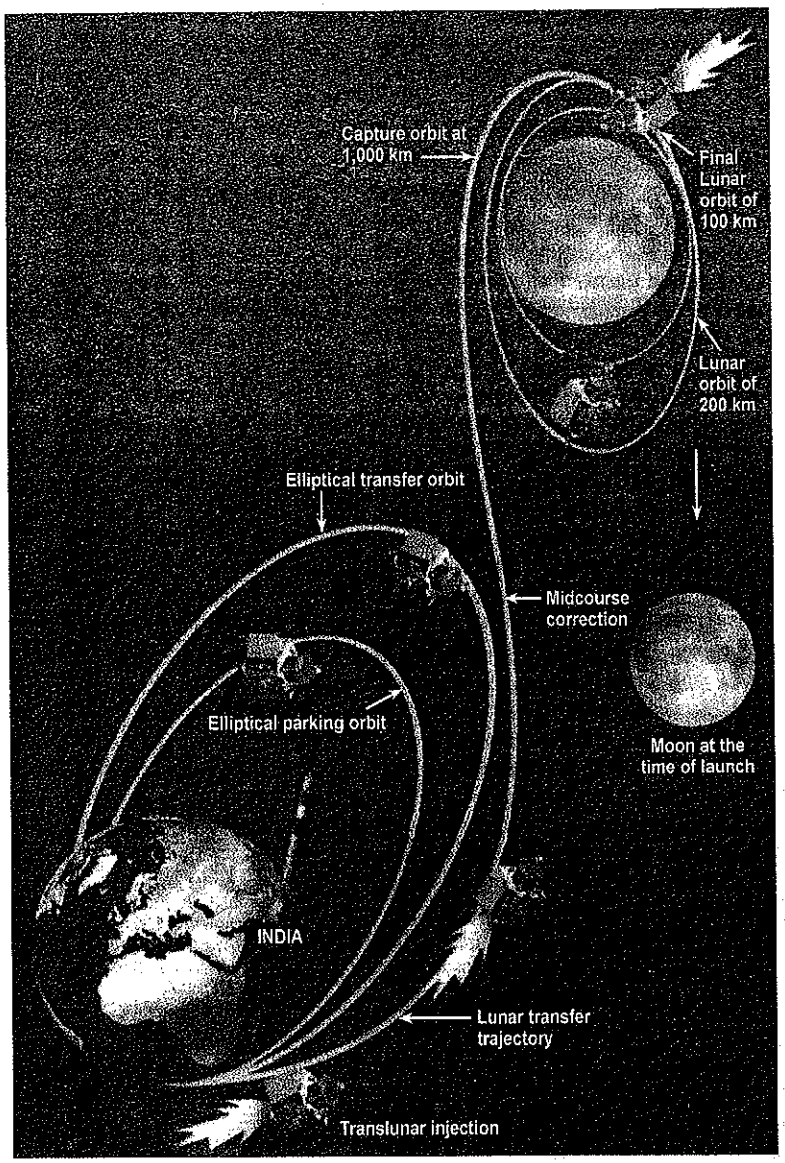

FIG. 26.13. Chandrayan

around the earth. The Chandrayan had a flawless take off and it was to ignited in four stages. Soon after its separation from the fourth stage. Chandrayan was initially placed in an orbital with its farthest point from the earth being 22,860 km. On October 28, 2008 it was raised to 4,77,515 km and on October 26, 2008, it became the first Indian spacecraft to enter deep space crossing the 1,50,000 km mark. On October 29, 2008, it went up to 2,67,000 km and its terrain mapping camera was switched on. On 4 November, 2008, the lunar orbitor flow into lunar transfer trajectory which meant that the Chandrayan had successfully entered the main highway to the Moon.

November 8, 2008 was the day of nerve-wracking and mail-biting because lunar orbit insertion (LOI) was being eagerly awaited. This is the most critical exercise because nearly 30 per cent of the unmanned lunar satellites by the U.S.A. and the erstwhile U.S.S.R. had failed at this point. This is due to the fact that the gravity of the earth and the moon cancel each other at this point. Fortunately, this hurdle was crossed and the speed of the spacecraft was reduced to 366 metres per second so that the craft could enter the moon's gravitational field. Its farthest point from the moon at this stage was 75.02 km which was gradually reduced and on 12 November, 2008, it reached the operational orbit of 100 km by 100 km. Still one major milestone to be crossed was crash landing of 29 kg indigenous Moon Improved Probe (MIP) about 32 km away from the Shackleton Crater in the Moon's South Pole. On 15 November, 2008, MIP slammed into the Moon's surface and India became the fifth country to show its presence on the Moon after the U.S., U.S.S.R., European Space Agency (17 countries) and Japan. The most outstanding feature of the Chandrayan was that its cost was only ₹ 386 crore which has been termed on the lowest expenditure according to international standards.

Immediately after landing on the moon's surface the Chandrayan started sending signals to ISRO Telemetry Tracking and Command Network (ISTRAC) at Bengaluru. The whole life of the Chandran was fixed for two years. But unfortunately on August 30, 2009, ISRO failed to restore the snapped communication link and the contact with the spacecraft was permanently lost. Consequently the mission was terminated. Still the ISRO believed that it was a great success as the Chandrayan completed about 95 per cent of the mission. Its major achievement among others, was the discovery of the widespread presence of water molecules in the linear soil.

Chandrayan-II. Indian space scientists were not much discouraged by partial failure of Chandrayan-I and they moved ahead with their plan to launch Chandrayan-II for gathering more information about the moon. Whereas Chandrayan-I was launched by Polar Satellite Launch Vehicle (PSLV), Chandrayan-II will be launched by Geosynchronous Satellite Launch Vehicle (GSLV) with a lift mass of 2560 kg. It will be a combo of three discrete spacecrafts—an Orbiter Craft module (OC), a Lander Craft module (LC) and a Rover that piggy backs the lunar surface on the lander and then drives off to explore the lunar surface surrounding the landing site. If all goes well Chandrayan-II will be launched by the end of 2016 or in the beginning of 2017.

Mangalyan

Mangalyan which is Sanskrit means Mars craft is Indias Mars Orbiter Mission (MOM). It was launched from Satish Dhawan Space Centre, at Sriharikota, using a Polar Satellite Launch Vehicle (PSLV) on 5 November, 2013. The MOM probe spent about a month in the earth orbit, where it made a series of seven altitude-raising orbital maneuvers before trans-Mars infection on 30 November, 2013. It crossed half way to Mars on 9 April, 2014. Currently it is being monitored from the Spacecraft Control Centre at ISRO Telemetry Tracking and Command Network (ISTRAC) in Bengaluru with support from Indian Deep Space Network (IDSN). Three stages of MOM are depicted in **Fig. 26.14**.

Major Milestones in India's Space Programme

1962 : Department of Atomic Energy forms the Indian National Committee for Space Research Work on Establishing Thumba Equatorial. Rocket Launching Station (TERLS).

November 21, 1963 : India launches first sounding rocket from TERLS.

1965 : Space Science and Technology Centre established in Thumba.

1967 : Satellite Telecommunication Earth Station set-up at Ahmedabad.

August 15, 1969 : Indian Space Research Organisation (ISRO) formed under Department of Atomic Energy.

June 1, 1972 : Space Commission and Department of Space (DOS) set-up. ISRO brought under DOS.

April 19, 1975 : ISRO launches first Indian satellite Aryabhatta.

August 10, 1979 : First experimental launch of SLV-3 with Rohini Technology Payload on board. Satellite can't be placed in orbit.

June 7, 1979 : An experimental satellite for earth observations, Bhaskara-1, launched.

July 18, 1980 : Second experimental launch of SLV-3, Rohini satellite successfully placed in orbit.

1981 : First developmental launch of SLV-3, Bhasakara-II launched, Apple, an experimental geo-stationary communication satellite launched.

1982 : INSAT-1A launched on April 10, deactivated on September 6.

1983 : INAT-1B launched.

1984 : Indo-Soviet manned space mission.

1988 : Launch of first operational Indian Remote Sensing Satellite, IRS-1A.

1992 : First satellite of the indigenously-built second generation INSAT series, INSAT-2A launched.

1993 : First developmental launch of PSLV. Satellite couldn't be placed in orbit.

1994 : Second developmental launch of PSLV. Satellite successfully placed in orbit.

1999 : India launches two foreign satellites, one from Germany and one from Korea, for first time as co-passenger satellites.

2001 : First developmental launch of GSLV-D1.

2003 : Second developmental launch of GSLV-D2.

2008 : PSLV-C11 successfully launches CHANDRAYAAN 1.

2013 : PSLV-C25 successfully launches Mars Orbiter Mission spacecraft.

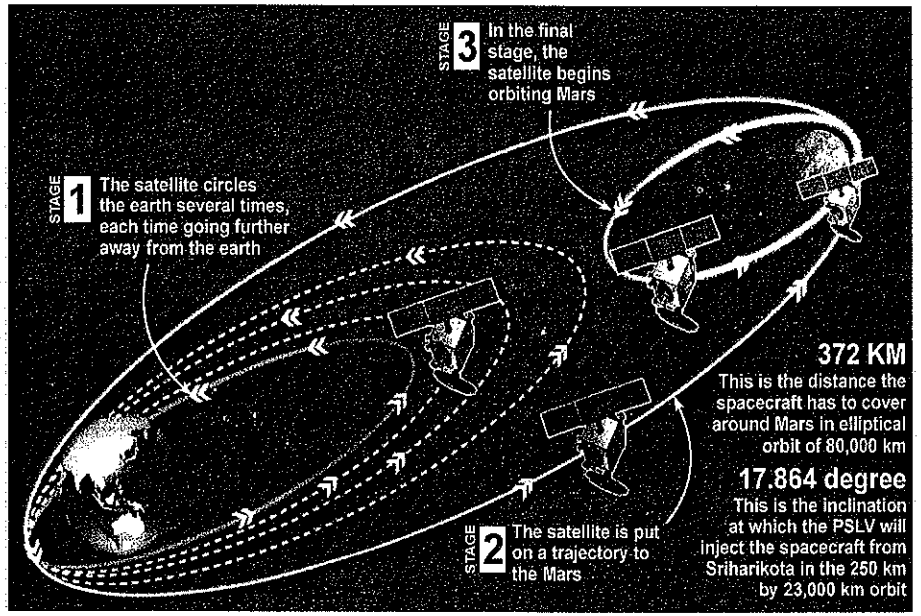

FIG. 26.14. Mangalyan's journey to Mars

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Foreign Trade

The exchange of goods or merchandise or their sale-purchase is known as trade. Trade is of three types (*i*) Local trade (*ii*) Regional trade and (*iii*) Foreign or International or Overseas trade. When one country exchanges goods or merchandise with another country, it is known as overseas trade or foreign trade. Advancement of international trade of a country leads to its economic prosperity. It is important both as a source of imports and as an outlet for exports. "International Trade of a country is rightly known as its *Economic Barometer*".

India has been maintaining trade links with China, Myanmar, Indonesia, Malaysia, Thailand, Iran, Iraq, Afghanistan, Saudi Arabia, Egypt, Greece, etc. since ancient times. With the establishment of British rule in India, our trade ties became stronger with Britain. India used to export raw materials such as cotton, tea, iron-ore, etc. to Britain and import manufactured goods, machinery, medicines, etc. from that country.

TRENDS IN INDIA'S FOREIGN TRADE

Table 27.1 shows the trends of foreign trade of India. There has been a rapid increase in the imports between 1950-51 and 1960-61. India had to import machinery and other items for industrial progress during that period. The value of exports increased considerably between 1960-61 and 1970-71 reducing the trade deficit from ₹ 480 crore in 1960-61 to a mere ₹ 99 crore in 1970-71. After that, both imports and exports have been increasing but imports have always been outpacing the exports. The rapid increase in India's overseas trade has been largely due to growth and diversification of Indian economy in the post-Independence era. However, inflationary trends and devaluation of the Indian currency have also contributed to increase in the volume of India's international trade :

Balance of Trade. All the countries of the world are importers as well as exporters of certain goods or services. *The difference between the value of a nation's exports and imports of all goods and services over a given period of time is called* ***balance of trade***. If the value of the total export is more than the value of the total import in a country, it has a ***positive balance*** of trade. A country with positive balance of trade is known as ***trade creditor nation***. If the value of the exports is lower than the value of imports, the country has a ***negative balance*** of trade. A country with negative balance of trade is known as a ***trade debtor nation***. **Table 27.1** shows that India's balance of trade has been invariably unfavourable. This is because of our increasing demands and growing economy.

TABLE 27.1. India's Foreign Trade (in ₹ crore)

Year	Imports	Exports	Total value of trade	Balance of trade
1950-51	608	606	1,214	–2
1960-61	1,122	642	1,764	–480
1970-71	1,634	1,535	3,169	–99
1980-81	12,549	6,710	19,259	–5,839
1990-91	43,193	32,558	75,751	–10,635
2000-01	2,30,873	2,03,571	4,34,444	–27,302
2005-06	6,60,409	4,56,418	11,156,827	–2,63,991
2006-07	8,40,506	5,71,779	14,12,285	–2,68,727
2007-08	11,02,312	6,55,864	16,63,576	–3,56,448
2008-09	13,74,436	8,40,755	22,15,191	–5,33,680
2009-10	13,63,736	8,45,534	23,09,270	–5,18,202
2010-11	16,83,467	11,42,922	28,26,389	–5,40,545
2011-12	23,45,463	14,65,959	38,11,422	–8,79,540
2012-13	26,69,162	16,34,319	4,30,3481	1034843
2013-14	27,14,182	18,94,182	46,08,364	–82,000

Source : (*i*) Directorate General of Commercial Intelligence and Statistics (DGCI&S), Kolkata.
(*ii*) India, 2014 Reference Annual, p. 140.
(*iii*) Economic Survey 2013-14, Statistical Appendix, p. 69.

In spite of the phenomenal growth of our foreign trade, India stands nowhere in the international market. As a matter of fact, India's share in the international trade has decreased with the passage of time. India's share in the international trade was 2.2 per cent in 1948-49 which declined to 1 per cent in 1963-64 and 0.4 per cent in 1995-96. Many other developing countries have excelled India in the overseas trade. India ranked 16th in 1953, 20th in 1963, 41st in 1983 and 50th in 1996 in the hierarchy of world nations doing overseas trade. However, India's foreign trade has recovered to a great extent since 2000-01. Improved global growth and recovery in world trade aided the strengthening of Indian exports. On the other hand, firming up of domestic economic activity, especially in the manufacturing sector, provided a strong support base for exports. Recent recovery in international commodity prices and various policy initiatives for export promotion and market diversification have also contributed to improve export performance. Consequently India's exports in recent past have continued to grow at a higher rate

As per press release of the World Trade Organisation (WTO) in April, 2013, India is the 19th largest exporter in the world with a share of 1.6 per cent and 10th largest importer with a share of 2.6 per cent in 2013. In commercial services, India is the 6th largest exporter with a share of 3.4 per cent and 7th largest importer with a share of 7.3 per cent.

Basis of Overseas Trade

Overseas trade depends upon several factors. Some important factors are discussed as under :

1. Difference in Natural Resources. The fundamental base of international trade is the difference in natural resources of different countries. There are variations in relief, structure, geology,

climate and soil from one country to the other. These variations lead to variations in natural resources. Some countries produce certain things more than their requirement and export them while some other countries may be lacking them and import those commodities.

2. Marketable Surplus. Some countries are capable of producing certain things more than their internal consumption. In other words, these countries have marketable surplus which they trade with those countries having demand for such products. For example, tea from India, coffee from Brazil, jute from Bangladesh, paper and pulp from Norway and Sweden, wood from Australia and petroleum from the middle East are available for export. Advanced countries like the United States of America, United Kingdom, Russia, Germany and Japan export finished goods.

3. Scarcity of Goods. There is not even a single country in the world which does not have scarcity of one commodity or the other. Japan and Britain do not have raw materials. Hence, these countries have to import raw materials from a large number of countries. Thus, scarcity of goods also encourages international trade. Japan depends heavily on iron ore supplies from India.

4. Transport and Communication. Trade involves exchange of goods which requires proper arrangement for transportation and communication. Land, water and air transport have helped international trade to a great extent. Heavy commodities like coal and iron ore as well as light and perishable commodities like milk and milk products, meat, fruits and vegetables etc. can be sent to all parts of the world by efficient means of transport and refrigeration. Countries with poor transport system have not been able to develop international trade. Realising the significant role played by transport system for promoting trade, India has launched an ambitious programme to improve surface transport. In addition, certain ports like Jawaharlal Nehru, Kandla, Tuticorin, Ennore, Paradwip, Haldia, etc. have either been developed or improved.

5. Disparities in Economic Growth. There are disparities in the economic growth in different parts of the world. Some countries are still engaged in primary activities such as agriculture, mining, etc. These countries mainly export minerals and agricultural raw materials. India's export consisted of raw materials for a pretty long time even after Independence. It is only recently that India has been able to diversify its exports as a result of diversification of her economic activities.

6. Trade Policy. Free trade policy encourages international trade whereas restrictions on the trade discourage it. For example, India has restricted the export of oil-seeds to meet the domestic demand. Similarly, India has imposed heavy import duty on certain finished goods to encourage industries at home.

7. War and Peace. Peace is the most important condition for the development of international trade. International trade gets disrupted during the time of war.

8. Political Relations. Countries having cordial political relations have better exchange of goods which encourages international trade. For example, India and Russia have good political relations and trade between these two countries has increased. On the other hand, the U.S.A. and Russia have strained political relations and trade between these two big countries is at low level. India's trade with the neighbouring Pakistan remained at low level ever since that country came into being in 1947 primarily due to strained political relations between the two countries. However, improved political relations between the two countries in the recent past have shown positive results. Exports to Pakistan had surged by almost three and half times since April-October, 2004.

COMPOSITION OF EXPORT TRADE OF INDIA

India has been a traditional exporter of raw materials since time immemorial. But the complexion of India's export trade has undergone a world of change since Independence. At present, Indian exports cover a wide range of items of agricultural, industrial, handicrafts, handloom and cottage sectors. Exports of electronic, hardware and software goods have increased considerably since the beginning of 1990s, and more significantly, these items are mainly destined to the advanced countries. The export growth

is gradually becoming broad based notwithstanding some deceleration in export growth of primary commodities. The major contributor to this increase has been the manufacturing sector in general, and engineering goods, chemicals and related products, leather and manufactures and gems and jewellery in particular.

1. Tea. India is a traditional exporter of tea in the world market. India has maintained its supremacy as an outstanding exporter of tea inspite of tough competition from the other tea producing countries. However, our percentage of tea and *mate* export in the world market has decreased considerably primarily, due to increased exports from other countries like Sri Lanka, China and Japan. In 2013-14 India exported 247.6 thousand tonnes of tea valued at about ₹ 4,832 crore. Britain has been the traditional buyer of our tea. Other important buyers are Russia, Poland, Iran, Egypt, Germany, Afghanistan, Netherlands, Australia and the USA.

2. Leather and Leather Goods. India has the largest population of livestock in the world which provide large quantity of leather in the shape of hides and skins. Previously, India used to export leather in its raw form but now the main export is that of leather goods. India exported leather and leather manufactures including leather footwear, leather travel goods and leather garments worth ₹ 28 crore in 1960-61 which rose to ₹ 298 crore in 1990-91 and to ₹ 34,517 crore in 2013-14. Footwear constitutes the most important item of leather exports. The USA, Russia, Germany, Britain, Yugoslavia, Italy, France and Japan are the main importers of our leather and leather goods. Recently, competition from China has grown considerably with respect to exports of leather and leather goods.

3. Ores and Minerals. India exports a large variety of ores and minerals which account for about one-fourth of our total exports. Higher international prices provided impetus to exports of metals and mineral ores.

(*a*) ***Precious stones, gems and jewellery*** have become the most important items of export from India in the recent past. They account for nearly 13.1 per cent of our total exports. This is the highest percentage accounted for by any single item of export. India imports gems and precious stones in their raw form and exports them after proper cutting and polishing. India was an insignificant exporter of gems and jewellery and the exports were worth ₹ 7 crore only in 1960-61 which increased to ₹ 2,48,465 crore in 2013-14. This speaks volumes of increase in our gem and jewellery exports. The USA, Switzerland, Japan, Belgium, Netherlands, France, Hong Kong, Singapore and countries of the Middle East are our main buyers. Improvement in off-take and recovery in major markets like the USA and Europe aided a pick up in exports of gems and jewellery. Israel and Belgium have emerged as our main competitors in the recent years.

(*b*) ***Iron ore*** is the single largest metal exported by India. High quality magnetite and hamatite ores are found in large quantities which are in great demand in the industrial countries. Japan is the largest buyer of our iron ore, purchasing more than two-thirds of our exports. The other customers are Korea, Romania, Russia, Malaysia, and Germany. India exported iron ore worth ₹ 956 crore in 2013-14. The recent trend has been to curtail the exports of iron ore and use it within the country to provide a solid base to iron and steel industry.

(*c*) ***Mica.*** India holds monopoly in the production of mica and is the largest exporter of mica in the world. In 2013-14, India exported mica valued at ₹ 304 crore.

(*d*) ***Chemicals and allied products*** account for about 13.2 per cent of our exports. The main buyers are Russia, the USA, Britain, the Netherlands, France, Saudi Arabia, Bangladesh, UAE, Indonesia, Thailand, Hongkong and Kuwait. The value of chemicals and allied products was ₹ 2,50,325 crore in 2013-14.

4. Engineering Goods. As a result of industrial progress, India is in a position to export engineering goods even to some of the advanced countries. In 1950-51, the Indian engineering goods exports were just ₹ 3 crore which jumped to ₹ 3,08,682.03 crore in 2012-13. Saudi Arabia, Japan, Iran, Sri Lanka, Uganda, etc. are the main purchasers of Indian engineering goods. Besides, electronic goods worth ₹ 7,992.39 crore were exported to advanced countries like the USA and Japan in 2003-04. Exports of engineering goods grew on the back of rising demand from countries in South-east Asia and China.

5. Cotton Textiles and Yarn. India now exports both inferior and superior quality cloth and yarn to different countries including the USA, Russia, Australia, New Zealand, the Netherlands, Britain, Germany, etc. While exports of manmade yarn, fabrics and made up increased, those of cotton yarn and fabrics were stagnant. In the year 2013-14, India exported cotton yarn, fabrics made ups, etc. worth ₹ 53,914 crore.

6. Readymade Garments. Readymade garments have become a very important item of export during the last few years. Indian readymade garments have become very popular even in some of the advanced countries due to their attractive designs, new fashion and colour combinations. They are competitively cheap in the foreign markets because labour is quite cheap in India. The total earnings from the export of readymade garments were ₹ 1,067 crore in 1985-86 which increased to ₹ 90,402 crore in 2013-14. In 2013-14, readymade garments accounted for about 4.8 per cent of the total exports of India which was next only to that of gems and jewellery.

7. Jute Manufactures. India was the largest producer and exporter of jute manufactures before partition in 1947. The partition of the country, introduction of substitutes and competition from other countries led to problems in the export of jute manufactures. In spite of these adversities, India has been doing well in the export of jute manufactures. India exported jute manufactures including twist and yarn valued at ₹ 2,296 crore in 2013-14. Eight countries purchase about two-third of our jute exports. These include the USA, Australia, Canada and European countries.

8. Marine Products. India is comparatively a new entrant in the export of marine products. The real progress in this field started after 1975. The total value of the exports of sea products was ₹132.15 crore in 1975 which rose to ₹ 18,833.06 crore in 2012-13. The main items of marine exports are fish, dried prawn and shrimps. India exports these products to over 80 countries. Japan and the USA purchase about 90 per cent of our exports. Other important customers are the Netherlands, Kuwait and France.

9. Coffee. India exports coffee to the USA, Russia and some European countries. In 2013-14, 278.9 thousand tonnes of coffee worth ₹ 4,797 crore was exported.

10. Spices. India has been a traditional exporter of spices. It was a major item of export of India during the British period. But its relative importance was reduced after Independence as a result of increase in other exports. The total quantity of spices exported in 2013-14 was 1,029.3 thousand tonnes and the total earnings from the export of spices in that year was ₹ 15,981 crore.

COMPOSITION OF IMPORT TRADE OF INDIA

Like exports, Indian imports have also increased manifold. India used to import mainly the manufactured goods before Independence. At the time of Independence, roughly 70 per cent of imports into India consisted of either manufactured consumer goods or inputs for manufacturing industries. But after that, the import of manufactured goods decreased gradually and our imports saw a large variety of goods. The demand for petroleum and petroleum products increased tremendously which made it necessary for us to import large quantities of these items. The other major items of import are machinery, tools, cereals, fertilizers, edible oils, iron and steel, pearls and precious stones, superior quality cotton and paper, etc. Like exports, India's imports are also tending to become broad based. The growth in imports has been contributed by robust increase in imports of food and allied products (mainly edible oils), capital goods, raw materials and manufactured intermediate and consumer goods.

1. Petroleum and Petroleum Products. This is the largest single item of import by India these days. There is great demand for petroleum and petroleum products and this demand is increasing at an accelerated rate. Transport and industry are two major sectors of consumption. In 2013-14, petroleum, oil and lubricants worth ₹ 10,00,064 crore were imported which accounted for 36.8 per cent of our total imports. In mid 1970s when the world was facing oil crisis due to Arab-Israel war, oil accounted for about 75 per cent of our import bill. Gulf war and disintegration of the former USSR in early 1990s had very adversely affected our oil supplies. Efforts are being made to increase the home production of oil so as to reduce dependence on the imports. Iran, Saudi Arabia, UAE, Iraq, Kuwait, Venezuela, Indonesia and Malaysia are the main sources of oil supply to India.

2. Machines. Special emphasis was laid on the industrial growth immediately after Independence which made it necessary to import machinery on a large scale. Now, most of the machines are manufactured in the country itself and only the machines involving high technology are imported. Textile machinery, electrical machines, farm implements and mining machines are the main items of import. These machines are mainly imported from the USA, Britain, Germany, Russia, France, Japan, Belgium, Poland, Italy, The Netherlands, Canada, Australia, etc.

3. Iron and Steel. Although there has been a considerable increase in the production of iron and steel in India, yet our production always falls short of our demand. This increase in demand has been largely due to the industrial growth in the country. India imported 7,406.3 thousand tonnes of iron and steel worth ₹ 47,912 crore in 2013-14 which was about 1.8 per cent of our total imports. Our main suppliers are Japan, Germany, Belgium, Britain and Korea. Japan supplies about 20 per cent of our total imports.

4. Minerals. Apart from iron and steel, India imports a large variety of minerals including copper, lead, tin, zinc, aluminium, etc. These minerals are imported from the USA, Britain, Japan, Germany, Switzerland, Australia, Myanmar and Malaysia, etc.

5. Fertilizers. The increasing demand for fertilizers for agricultural growth has to be met by imports. India imported 22,154.2 thousand tonnes of fertilizers worth ₹ 38,231 crore in 2013-14. The USA, Germany and Japan are the main sources of fertilizers.

6. Pearls and Precious Stones. India imports a large quantity of pearls and precious stones in their raw form and exports them after cutting and polishing. The real increase in their imports has been seen after 1970. The import bill of pearls, precious and semi-precious stones, both worked and unworked was a meagre ₹ 1 crore in 1960-61 which shot up to ₹ 25 crore in 1970-71. ₹ 3,738 crore in 1990-91 and ₹ 1,44,557 crore in 2013-14.

7. Gold and Silver. Gold and silver have also become very important items of import. After a decline of 6.4 per cent in 2002-03, the gold and silver imports (excluding imports through passenger baggage), picked up sharply by 59.9 per cent in 2003-04, notwithstanding a rise in international bullion market. These imports seem to have been buoyed up by recovery in domestic demand, on the back of agricultural rebound and strengthening of rupee against the US dollar. The duty reduction on imported gold from ₹ 250 to ₹ 100 per 10 gram, and liberalization of such imports as per trade facilitation measures announced in January 2004 may have also provided a demand fillip. However, fall of Indian currency against $ US in early 2010s put some restriction on imports of gold and silver but it has bounced back. Value of imports of gold and silver increased to ₹ 3,02,921.96 in 2012-13 as against ₹ 2,94,255.18 in 2011-12.

8. Edible Oils. The production of edible oils has always been falling short of our demand which is met by imports. In 2013-14 about 10,434.2 thousand tonnes of edible oils costing ₹ 56,489 crore were imported. The corresponding figures for 1995-96 were 1,062 thousand tonnes and ₹ 2,260 crore. The USA, Brazil and Malaysia are the main sources of edible oils for India. These three countries supply about three-fourths of our edible oils.

9. Chemicals. India imports a large variety of chemicals including ammonia, sulphate, super phosphate, nitric acid, soda ash, bleaching powder and potash. India imported chemical elements and components worth ₹ 22,498 crore in 2013-14. The main sources of our chemicals are the USA, Japan, Germany, the Netherlands, Belgium, France, Britain, Italy, Kuwait and Korea.

10. Medicines. Large quantities of medicines are required to provide increasing medical treatment to the fast-growing population of India. A part of this requirement is met by importing medicines especially costly and life-saving drugs. India spent ₹ 17,944 crore in 2013-14 to import medicinal and pharmaceutical products. About half the imports are from Germany, Italy, China, Switzerland, Spain, Belgium and Poland.

11. Paper. With the increase in literacy and publication, India is finding it hard to meet her requirements from the indigenous production and has to import paper. The shortage of newsprint is badly felt. Pulp and scrap paper are also imported to manufacture paper. India imported 3,648.8 thousand

tonnes of pulp and waste paper worth ₹ 8,378 crore and 2,761.3 thousand tonnes of paper, paper board and manufactures thereof worth ₹ 15,067 crore in 2013-14. Russia, Sweden, Germany, Bangladesh, Brazil, China, Czech Republic, Slovakia and Korea are the main suppliers of these items.

12. Fibres. Although India is a major producer of fibres, she has to import different varieties of fibres to feed her textile industries which are growing at a fast speed. The main fibres imported are raw cotton, raw wool, raw jute and synthetic fibres.

(a) Raw Cotton. Although India is a big exporter of inferior quality cotton, she has to import superior quality cotton. Egypt, Uganda, the USA, Tanzania, Sudan and Peru are important suppliers. India imported 177.7 thousand tonnes of raw cotton worth ₹ 2,371 crore in 2013-14.

(b) Raw Wool. Large proportion of wool produced in India is of inferior quality and large quantity of superior wool is imported mainly from Australia. India had to spend ₹ 1,962 crore on the import of 89.6 thousand tonnes of raw wool in 2013-14.

(c) Raw Jute. India's jute supplies were drastically cut as a result of partition of the country in 1947, because most of the jute producing areas went to present Bangladesh. Strenuous efforts have been made to increase area and production of jute within the country, but demand of raw jute by jute textile industry far outstrips the supply. Therefore, India has to import raw jute primarily from Bangladesh. In 2013-14, India imported 52.7 thousand tonnes of raw jute at the cost of ₹ 146 crore.

(d) Synthetic Fibres. With the diversification of the textile industry and with trend in favour of synthetic fibres, the demand for these fibres is increasing rapidly; a large part of which has to be met by imports. India spent ₹ 502 crore to import 73.3 thousand tonnes of synthetic fibres in 1995-96. However, the corresponding figures were ₹ 1,889 crore and 119.3 thousand tonnes respectively in 2013-14.

DIRECTION OF INDIA'S FOREIGN TRADE

Direction of foreign trade means those regions and countries with which India has trade relations. Although we have trade contacts with almost all the countries of the world, yet there are certain countries which are more important than the others.

Britain was our most important trade partner before Independence. This was the result of the policy of exploitation of India by the British rulers. They exploited the natural resources of India to get the raw materials and created a vast market here for their manufactured goods. But the situation has drastically changed since Independence. Direction of India's exports and imports from different regions/sub-regions is outlined in **Table 27.2**.

TABLE 27.2. Direction of India's Foreign Trade (2012-13)

Region	Percentage Share
1. Europe	18.6
1.1. European Union Countries	16.75
1.2. European Free Trade Association (EFTA)	0.46
1.3. Other European Countries	1.4
2. Africa	9.7
3. America	17.75
3.1. North America	13.24
3.2. Latin America	4.51
4. Asia	50.76
4.1 East Asia (Oceanic)	0.91
4.2 ASEAN	10.96
4.3. West Asia	20.76
4.4. N.E. Asia	13.21
4.5. South Asia	4.91
5. CIS and Baltics	1.24
6. Unspecified Region	1.95
Total	100.00

Source : India 2014, A Reference Annual, pp.142-43.

SALIENT FEATURES OF FOREIGN TRADE OF INDIA

1. Negative or Unfavourable Trade. India had to import various items like heavy machinery, agricultural implements, mineral oil and metals on a large scale after Independence for economic growth. But our exports could not keep pace with our imports which left us with negative or unfavourable trade. This situation still persists and is clear from **Table 27.1**.

2. Diversity in Exports. Previously, India used to export its traditional commodities only which included tea, jute, cotton textiles, leather, etc. But great diversity has been observed in India's export commodities during the last few years. India now exports over 7,500 commodities. Since 1991, India has emerged as a major exporter of computer software and that too to some of the advanced countries like the USA and Japan.

3. Worldwide Trade. India had trade links with Britain and a few selected countries only before Independence. But now India has trade links with almost all the regions of the world. India exports its goods to as many as 190 countries and imports from 140 countries.

4. Change in Imports. Earlier we used to import foodgrains and manufactured goods only. But now oil is the largest single commodity imported by India. Both the imports as well as exports of pearls and precious stones has increased considerably during the last few years. Our other important commodities of import are iron and steel, fertilizers, edible oils and paper.

5. Maritime Trade. About 95 per cent of our foreign trade is done through sea routes. Trade through land routes is possible with neighbouring countries only. But unfortunately, all our neighbouring countries including China, Nepal, Myanmar are cut off from India by lofty mountain ranges which makes trade by land routes rather difficult. We can have easy access through land routes with Pakistan only but the trade suffered heavily due to political differences between the two countries.

6. Trade through a few Selected Ports Only. We have only 13 major ports along the coast of India which handle the major part of overseas trade of India. Very small amount of foreign trade is handled by the remaining medium and small ports.

7. Insignificant Place of India in the World Overseas Trade. Although India has over 17 per cent of the world's population, her share in the world overseas trade is less than one per cent. This shows the insignificant place of India in the world's overseas trade. This is, however, partly due to very large internal trade, vast dimensions of the country provide a solid base for inter-state trade within the country. Europe is divided into a large number of smaller countries and the international trade is quite high (trade counted twice, first time as exports and second times as imports).

8. State Trading. Most of India's overseas trade is done in public sector by state agencies and very little trade is done by individuals.

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Tourism

INTRODUCTION AND DEFINITION

Tourism has different meanings in different languages and different regions and can be defined in different ways. The present day tourism is not the same as travels of the early periods of human history. In the language of Jew, the word '*Torah*' mean study or search and 'tour' seems to have been derived from it. In Latin the original word '*Tornos*' stands close to it. 'Tornos' was a kind of round wheel-like tool hinting at the idea of a travel circuit or a package tour. In Sanskrit, '*Paryatan*' means leaving one's residence to travel for the sake of rest and for seeking knowledge. '*Deshatan*' is another word which means travelling for economic benefits. '*Tirthatan*' is the third equivalent which means travelling for religious purposes. All the three words convey the meaning and concept of tourism much more appropriately, as well as comprehensively.

Tourism as a modern term is applicable to both international and domestic tourists. It is the *temporary movement of people to destinations outside their normal place of work and residence*. Such a pleasure-seeking tourist is a traveller moving from place to place or visiting the same place time and again. Tourism includes all economic activities which are organised to fulfill the needs of such travellers. Any travel for holidaying, business or professional trips becomes a part of tourism if it is temporary, is undertaken voluntarily and does not aim at earning any livelihood.

According to **Ziffer** (1989), *"Tourism involves travelling to relatively undisturbed or uncontaminated natural areas with the specific object of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural aspects (both past and present) found in these areas"*. Tourism for some provides entertainment, for others it serves as a holiday and for yet others it is a means of understanding other peoples' ways of life, cultures and traditions. According to a Chinese proverb, *"Travelling a mile imparts more knowledge than reading a mile of written words."* In today's world, tourism is an important socio-economic activity. Tourism is now recognised as an industry generating a number of social and economic benefits. It promotes national integration and international understanding, helps in improving infrastructure, creates employment opportunities and augments foreign exchange earnings. Tourism is as much a part of socio-economic development as any other related acitvity. The advanced economies of the west and the emerging economies of south-east Asia underline the linkage between tourism and growth. In any area where a place of tourist attraction is located, there exists a tourist economy besides the domestic area economy. It also lends a helping hand to local handicrafts and cultural activities.

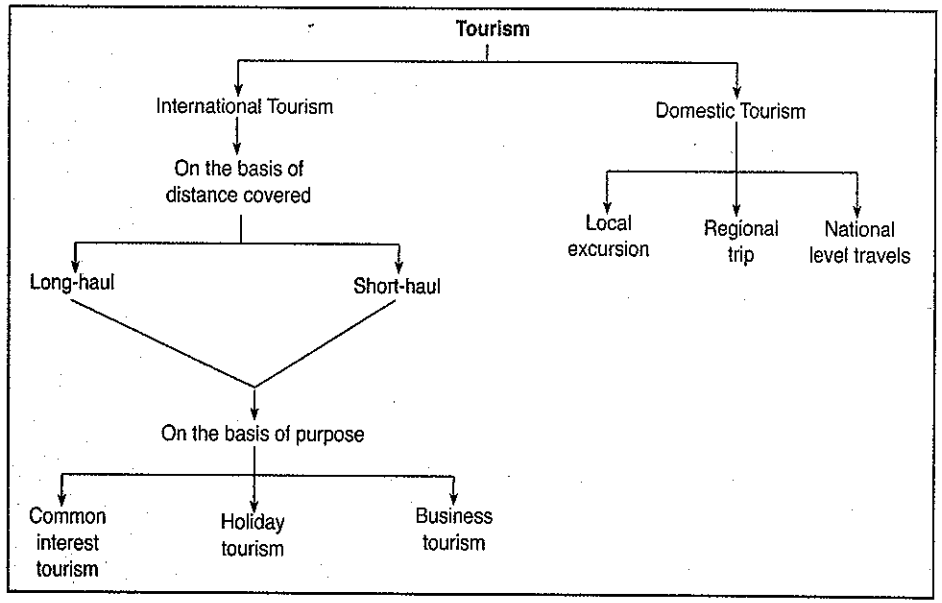

FIG. 28.1. Types of Tourism

Types of Tourism

Different types of tourism can be recognised depending on length of stay, mode of transport used, distance travelled, purpose of trip and price paid by tourists. Broadly speaking, there are four major types of tourism namely : (*i*) international tourism, (*ii*) domestic tourism, (*iii*) long distance tourism, and (*v*) short distance tourism.

(*i*) International Tourism. An international tourist crosses the boundaries of one or more countries, uses different currencies, faces different languages and meets different types of people. Usually international tourism involves longer distances although crossing small countries or travelling in the neighbourhood of international borders may involve short distances.

(*ii*) Domestic Tourism. It is concerned with travelling within the country. It does not need a passport and visa or conversion of one currency into another. Domestic tourism has greater scope in countries of large dimensions such as India as compared to smaller countries. From a geographical viewpoint, domestic tourism may range from local excursion, regional trips to national level travels.

On the basis of purpose of tour or the motives of tourists, tourism is of three types, *viz.*, (*a*) common interest tourism, (*b*) holiday tourism and (*c*) business tourism. In case of *common interest tourism,* the purpose of visiting and the visited persons in common. Visiting friends and relatives in this type puts very low pressure on the provision of tourist facilities at the destination. *Holiday tourism* is the most popular type. A fine weather favourable for sightseeing, touring, recreation and going round different cultural sites are sought after by incoming tourists of this category. *Business tourists* travel to boost their business, attend trade fairs and conferences pertaining to commerce or professions. They combine business with recreation using same facilities as provided for holiday tourists.

Nature's Gift for Tourism

Nature is bountiful and provides vast opportunities in form of gifts to enhance tourism.

1. Weather and Climate Resources. India is vast country and its different parts experience different types of climate. This extraordinary asset in the form of varied climates can be encashed to promote tourism in the country by attracting tourists from far and near. Regional variations in the climate of India are caused by five main factors, *viz.*, (*i*) the vast size of the country, (*ii*) tapering of the peninsular India towards the south, (*iii*) the latitudinal extent astride the Tropic of Cancer, (*iv*) situation at the head of the Indian Ocean, and (*v*) role played by the Himalayas as a climatic barrier between India and central Asia, protecting the country from cold and dry winds from central Asia during winters. A tourist will find different types of climate in the Great Plain of North India, the snow covered Himalayas, in the peninsular plateau area and in the coastal regions. There are climatic variations from one state to another and even from one district to another. These climatic variations are of great advantage to engage tourists in a variety of activities during their stay in the country. However, strong influence of the monsoons along with their typical rhythm provides underlying unity to India's climatic diversity. This unity in diversity of the Indian climate is a potent factor which works to attract tourists. The visiting tourist can choose to stay in any type of climate and enjoy the changing status of weather while moving from one place to another. Temporal changes in weather are no less pronounced than the spatial changes. India is one of the few countries where there is change in weather after every two months. The spatial and temporal changes in India's climate and weather act as a great magnet to attract tourists and enable them to enjoy the gift of nature. Larger the diversity, greater is the potential of climate resources to develop tourism.

2. Landscape Resources. Geology and physiography are two major bases of landscape resources. These two aspects influence the landscape and determine the rocky peaks for climbing, cliffs or scarps for hand gliding, steep snowy slopes for skiing and caves for exploiting them for sightseeing. Rock formations exposed in areas like Deccan plateau or Ladakh attract tourists interested in trekking. There is ample scope for rural tourism also. Water bodies and waterpoints like riversides, gorges, waterfalls, springs, etc. provide spectacular views to the tourists. Sunbathing and adventurous raffling and rowing are associated with water tourism.

Although all sorts of landscape resources attract tourists, yet the degree to which different types of landscapes act as tourists attraction varies greatly. According a research report by A. Gilg of Exter University in U.K., mountains comprise the greatest attraction for the tourist. The other features, in descending order are bold hills, hilly country, plateau uplands and lowlands.

Forest landscape is found to be equally attractive, irrespective of topography. It is for this reason that National Parks, Sanctuaries as well as Biosphere Reserves are used as tourist spots. Seeing wildlife in its natural habitat rather than in a zoo or a safari-park is termed as Nature Tourism these days. Vegetation in wilderness and wildlife which depends on it constitute a very important element of tourist landscape.

3. Seascape Tourist Resources. Coastal waters of the mainland of India and that of the groups of islands (Andaman & Nicobar Islands in Bay of Bengal and Lakshadweep in Arabian Sea) comprise another major source of tourist attraction. Sandy beaches, coves, spits and lagoons, reefs and seaside cliffs are tourist hot spots. These are visited for sunbathing, swimming, boating and surfing. This type of tourism flourishes only in those areas where waves are gentle and tidal currents are not dangerous.

4. Historical and Cultural Resources. These are manmade features and are found in almost all parts of the country. Such resources are associated with historical, religious or cultural events. A rich historical and cultural heritage has developed during long course of history of India. These include statues, shrines, tombs, minarets, forts, palaces, ancient monuments as well as recent buildings and are famous for their architectural designs and structural beauty.

Classification of Tourist Resorts

There are several types of tourist resorts depending on their location in different geographic regions, diverse characteristics of their sites, and scope for a variety of tourists activities. A brief classification of tourist resorts is given as under :

1. Mountain and Hill Resorts. Almost all mountainous and hilly areas of India are dotted with places of tourist interest. In the north are the Himalayan ranges; blessed with scenic beauty which is beyond description. Besides, there are high hills in the northeast and in and around the Nilgiris in the south. There are hill ranges of medium to low heights in the Western Ghats, Vindhyas, Satpuras and the Aravalis in addition to isolated hillocks elsewhere. Hill resorts are divided into following three categories according to their altitude.

(*a*) Resorts at great heights (between 2,100—3,500 metres above mean sea level).

(*b*) Hill resorts at medium altitudes (between 1,200 and 2,100 metres above mean sea level).

(*c*) Hill resorts at low altitudes (between 800 and 1,200 metres above mean sea level).

Map in **Figure 28.2** shows that the maximum number of hill resorts are at medium heights followed by those located at low heights. Very few tourist resorts are at very great heights.

2. Beach Resorts. The long coastline of India has several beaches which offer ample scope for promotion of beach tourism. A number of beautiful beaches of Goa and that of Kovalam in Kerala are quite popular with the tourists. There are vast stretches of shining golden sands of beaches at Chorwad and Ahmedpur-Mandvi. The Maharashtra coast has eight small beaches from Mumbai's famous Juhu to Murud at a distance of 220 km. Goa's 105 km long coastline has as many as 40 beaches, out of which 12 are very popular with the tourists. Karnataka's beaches are at Mangalore and Karwar. The sun-swept Marina beach in Chennai (Tamil Nadu) is the world's second longest beach. It runs for a distance of 12 km from Chennai harbour in the north to Santhome (St. Thomas) Church in the south. Two beaches of Andhra Pradesh, namely Ramakrishna Mission and Rishi Konda are located in the close proximity of Vishakhapatnam. Odisha's Gopalpur beach is surrounded by sand dunes. Besides Puri and Konark, Chandipur near Balasore is known for its 55 km recession of the tides each day at its head. Digha beach of West Bengal is very close to the Ganga's mouth. With a total length of 6 km it is one of the widest in the world amidst gently rolling sea and thick casuarina forest on its two sides.

3. Cultural Centres (Heritage Tourism). India is proud of being very rich in heritage tourism. Her cultural centres are of varied types, the outstanding centres being temples or pilgrim centres (of all faiths), ancient ruins, forts, memorials, palaces, places of historical importance and gardens. These cultural centres are distributed all over the length and breadth of India.

4. Adventure Tourism (Off-beat Resorts). Adventure tourism includes a large variety of activities such as trekking, skiing, river rafting, water games, mountaineering, rock climbing, hang gliding, para gliding, hiking and camping in habitats of wild life. This type of tourism is not very popular as only about 7 per cent of the total tourists traffic opt for adventure tourism. However, there is great scope of making it popular if young people particularly in the age-group of 25-35 years are motivated for adventure tourism.

(*i*) ***Trekking.*** Trekking involves walking or hiking over long distance for fun and recreation. The real thrill of trekking comes by walking over rugged and remote terrain lacking in good means of transport, going up and down the hills, crossing passes and coping with extremes of variable weather in high altitudes. Some of the well defined trekking routes are marked in Ladakh, Uttarakhand, Sikkim, Arunachal Pradesh, etc.

(*ii*) ***Mountaineering.*** Lofty peaks in the Himalayan region have attracted mountaineers from all over the world. Mountaineering became very popular with the adventure lovers after the conquest of Mount Everest in 1953. The Himalayan region has the largest number of high peaks in the world. Most of the high peaks are under permanent snow and throw great challenge to mountaineers. In Jammu and Kashmir, there are a series of mountain peaks in Pir Panjal, Great Himalaya, Zaskar, Ladakh and Karakoram ranges. These are between 5,000 and 7,000 metres above sea level. High Himalayan ranges in Himachal Pradesh have about 150 peaks located at altitudes of over 5,400 metre. On an average, there is one high peak after every 20 km. In Uttarakhand, the source of the holy Ganga, a few kilometres above Gau Mukh ice cave, lies one of the best mountaineering areas of the world. Towards the east, Sikkim offers great opportunities to climbers. The Indian Mountaineering Institutes at Manali,

Darjeeling and Uttar Kashi and the Indian Mountaineering Foundation at Delhi render valuable help and guidance in organising and sponsoring the mountaineering expeditions.

*(iii) **Winter Sports Resorts.*** Winter sports have become very popular with tourists (both Indian and foreign) in the recent past. Skiing is one of the most popular winter sports on the snowy slopes of

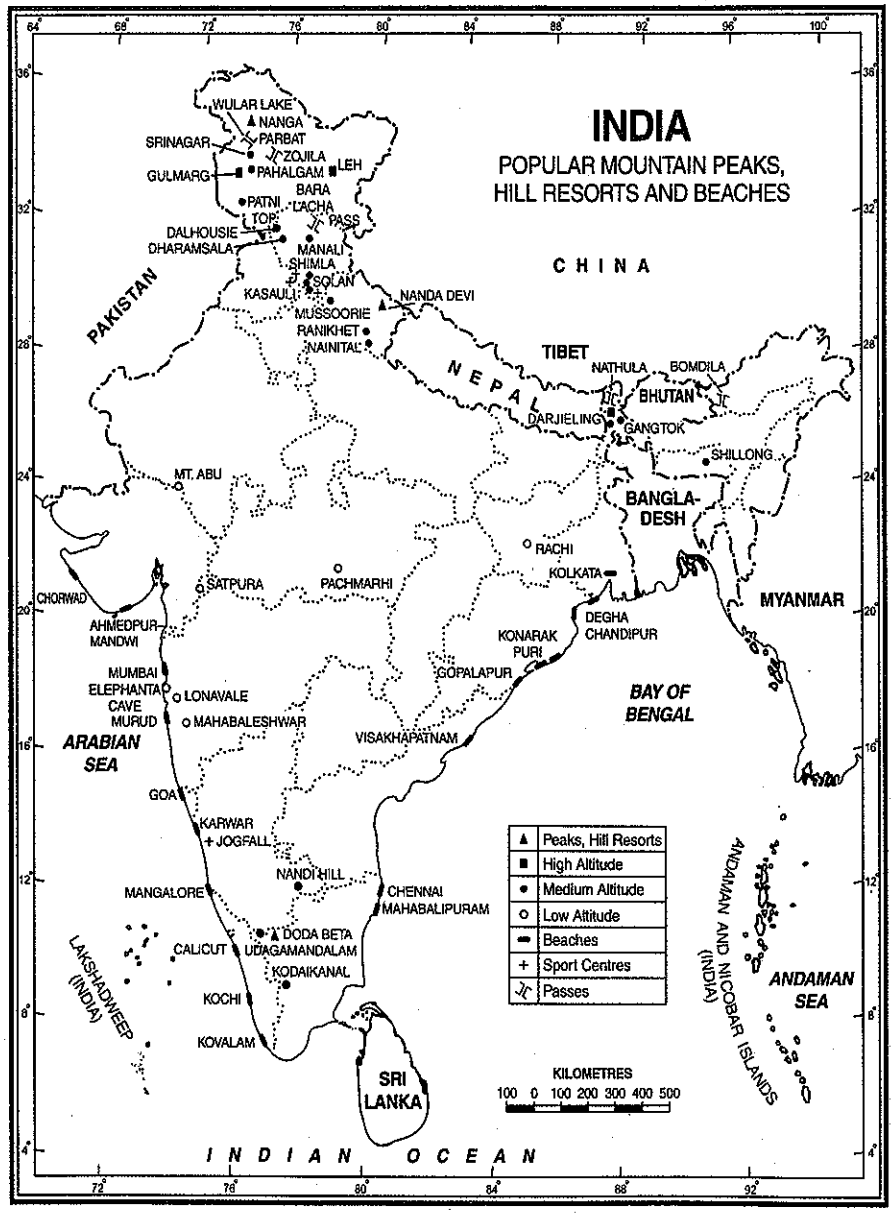

FIG. 28.2. Popular Mountains Peaks, Hill Resorts and Beaches

Himalayas, Gulmarg (2,730 m) in Jammu & Kashmir, Narmada (2,700 m), Kufri near Shimla as well as slopes along Solang Nala close to Manali in Himachal Pradesh and Auli near Joshimath in Uttarakhand offer excellent opportunities for winter sports.

*(iv) **Hand gliding and Paragliding.*** These two sports are full of thrill as they give the joy of soaring high in the sky. Facilities for this sport are available in the valleys of Bilaspur, Manali and Bir (Kangra) in Himachal Pradesh and at Udagamandalam in Tamil Nadu.

*(v) **Water Sports Tourism.*** Rafting is the most important of all the water sports in India. It has become quite popular in the recent past and has tremendous scope for promotion in the near future. Facilities for rafting exist in Ganga near Rishikesh, Beas near Manali and Indus in Ladakh. However, Tista in Sikkim, Brahmaputra in Assam, Chandra in Lahul (Himachal Pradesh) and Bharati in Arunachal Pradesh hold great potential with regard to rafting.

India's numerous natural and man-made lakes offer large scope for developing aquatic games like sailing, angling of trout fish and wind surfing. Rivers and canals criss crossing Goa have been developed as water bodies for water sports.

Clear sea water surrounding Andaman and Nicobar Islands in Bay of Bengal and Lakshadweep in Arabian Sea provide ideal sites for developing diving sports.

*(vi) **Cave Tourism.*** India has a large number of caves and rock-cut temples some of which still await development as tourist designations. There are about 30 caves around Aurangabad, of which Ajanta is the most popular. Around 500 caves are found around Pachmarhi in Madhya Pradesh. Some of them have paintings of early man. The twin hills of Khandagiri and Uraygiri near Bhubaneshwar have caves showing rock sculpture. Cherrapunji in the Garo hills of Meghalaya has a beautiful cave in limestone area. The cave has well developed stalactite and stalagmite formations. A recent discovery of Asia's longest 19.2 km cave besides 200 other caves in the Jaintia hills of Meghalaya has given a big boost to cave tourism in this state. Cave tourism has a large number of attractions varying from their sites, geological formations to rock paintings, sculpture myths and legends.

*(vii) **Wilderness Tourism.*** With her rich and diverse biological heritage in the form of varied flora and fauna, India offers vast scope for wilderness tourism. Wilderness tourism develops on National parks, sanctuaries and wetlands. National parks and sanctuaries have already been discussed in chapter on *Natural Vegetation* and need not be repeated here.

Growth of Tourism in India

Tourism in India has a strong relevance to economic development, cultural growth and national integration. As mentioned earlier, India is a vast country of great beauty and diversity and her tourist potential is equally vast. With her rich cultural heritage as superbly manifest in many of the architectural wonders (palaces, temples, mosques, forts, etc), caves and prehistoric wall paintings, her widely varied topography ranging from the monotonous plains to the loftiest mountains of the world, her large climatic variations ranging from some of the wettest and the driest as well as from the hottest and the coldest parts of the world, beautiful long beaches on the sea coast, vast stretches of sands, gregarious tropical forests and above all, the great variety of the life-style, India offers an unending choice for the tourist.

The roots of tourism in India can be traced to pilgrimage. Places of pilgrimage provided a firm ground to tourism in the beginning and still continues to be one of the most effective factors of promoting tourism in India. It is interesting to note that in the early stages, pilgrimage based tourism was only of domestic nature but during recent years, an increasingly large number of foreign tourists have also started visiting places of pilgrimage. With other attractions gradually gaining ground, one can notice detectable changes in the character of Indian tourism, with a tilt from pilgrimage to pleasure trips. Today, the majority of the tourists feel that travelling for sheer *pleasure* offers much wider scope than that offered by *pilgrimage* and thus the former is always more colourful, lively, intimate, soothing to mind and body and hence, more enjoyable. Sometimes, people combine pilgrimage with pleasure trips to draw the benefit of both.

Organised tourism in India began in the 1950s with the genesis of planned development. Over the years, Indian tourism has grown considerably as is

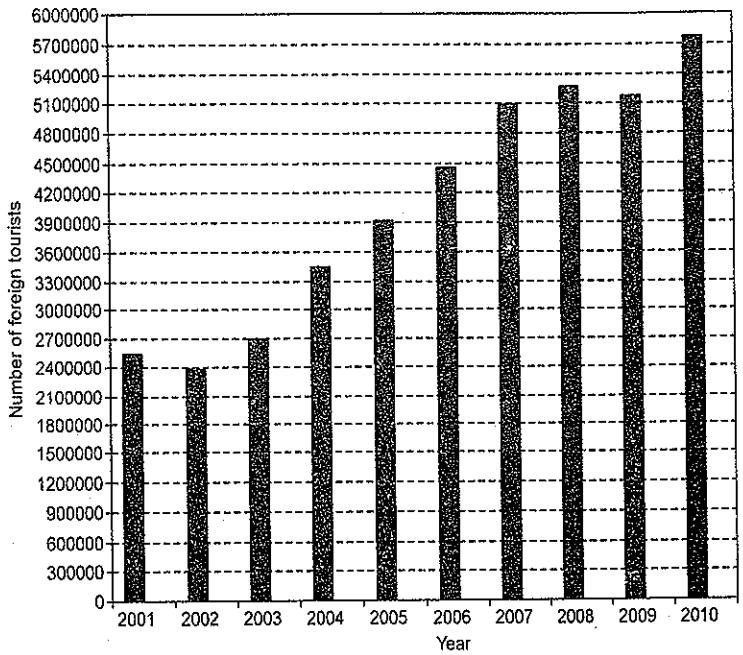

Fig. 28.3. Number of foreign tourists to India (Based on Statistical Year Book India, 2013)

indicated by the arrival of foreign tourists (*see* **Fig. 28.3**). This shows that the number of foreign tourists visiting India has increased substantially from about 2.5 million in 2001 to 5.77 million in 2010. This means that the number of foreign tourists visiting India has doubled within tone decade from 2001 to 2010. According to World Tourism Organisation, by the year 2020, it is expected that India will become the leader of tourism industry in South Asia. Of late the Indian tourism economy has been deemed as the second most rapidly increasing (8.8%) tourism economy in the world, by World Travel and Tourism.

With the successful launch of very penetrative ad campaign—Incredible India—there seems to be revival of increasing trend in the tourist arrivals. This, coupled with the open sky policy and good private-government partnership, is bringing back foreign tourists to India. Visa-on-Arrival (VoA) scheme was started from January 2010 on pilot basis for nationals of five countries, namely Finland, Japan, Luxembourg, New Zealand and Singapore. A total of 5,644 VoA were issued during January-November, 2010. The scheme is being extended to five more countries, namely Colombia, Laos, Philippines, Myanmar and Vietnam from January, 2011.

Figure 28.4 shows that a maximum of 16% foreign tourists to India visit from the U.S.A. which is followed by the U.K. (13%). Our neighbouring countries namely Bangladesh and Sri Lanka account for 8% and 5% respectively of the total foreign tourists visiting India. Canada, France and Germany each send 4% foreign tourists to India while Australia, Japan and Malaysia account for 3% each.

Business Tourism

Another healthy trend in the foreign tourism in India since 1991 has been a conspicuous increase in business travel with its spinoff effects in upgradation of accommodation and introduction of new technology in communications and other services. The metropolitan cities like Delhi, Mumbai, Chennai, Kolkata, Bengaluru, Hyderabad, etc. have experienced phenomenal growth in travel by business class people, some of whom combine business with pleasure. This trend has encouraged entrepreneurs and industrial houses to invest in hotel business apart

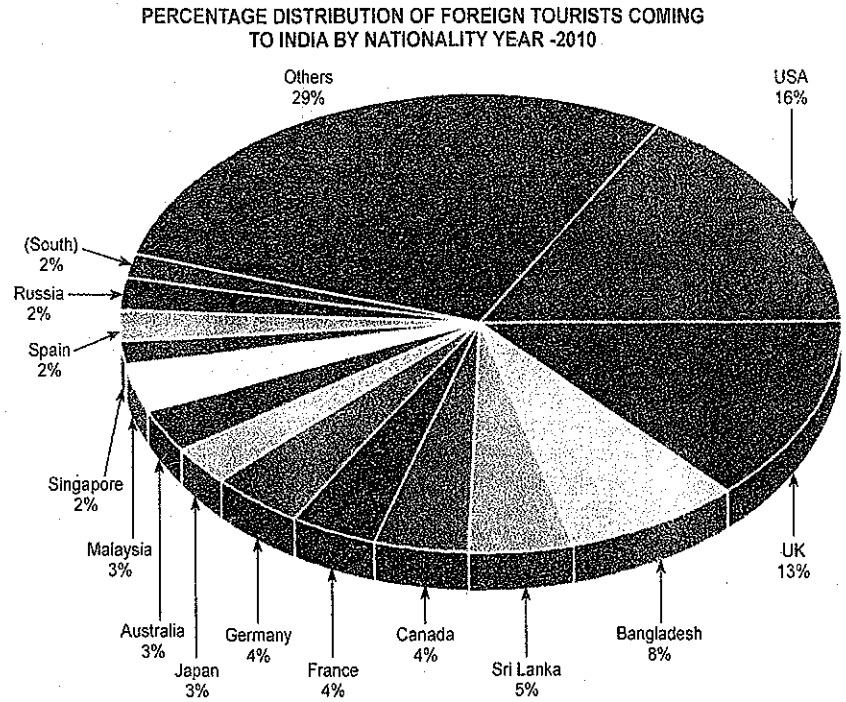

Fig. 28.4. Percentage distribution of foreign tourists coming to India by nationality (2010) (Based on Statistical Year Book, India, 2013)

from the existing chains to go in for large scale expansion and diversification of the hotel industry. On an average, a foreign tourist stays for about 27 days in India, but there are wide variations in the duration of stay by people from different parts of the world. The duration of stay of the foreign tourists in India is an important indicator of foreign exchange earned by the country.

Medical Tourism

Medical tourism is a recent trend which India is increasingly experiencing and is gaining a lot in terms of foreign exchange and goodwill—both in terms of medical treatment and tourist destination. India is fast emerging as a potential destination for medical tourism as foreign patients flee the chronic inefficiency of their own health services to more economical and effective alternatives in New Delhi and other Indian cities.

A report by the consultancy firm McKinsey in 2003 stated that the travel trade could earn upmarket hospitals around $ 2.17 billion by 2012; with thousands of people travelling to India for medical treatment. Patients in U.K. and U.S.A., South Africa, West Asia and South-East Asia are increasingly opting for private Indian hospitals. They are tempted by hospitality, swift treatment, economical pricing and world class quality of treatment. For example, a heart bypass costs £ 500 in India as against £ 5,000 in the U.K. British hip replacement surgery costs £ 6,600 in U.K. while in India it is available for just £ 860. In addition to cost factor, speed is a powerful incentive in India as there is no need for referrals or long waits. This important factor has led to Britain negotiating with some of the top hospitals in New Delhi to bring some of the patients to India who would otherwise have to wait for months or even for years to undergo routine operations on its National Health Service. Besides, patients in U.K. and the U.S.A. cannot avail of their insurance for not-critical treatment, such as knee replacement or cosmetic surgery. Under such circumstances, cost becomes an

imperative factor and patients opt for cheapter and good quality good treatment in India.

It is interesting to note that the main demand for medical tourism comes from about 20 million Indians living abroad, although the number of foreigners who are keen to avail of speedy, inexpensive and quality treatment in India is growing at a rapid pace. Two major factors influencing this trend are (*i*) world class private hospitals, and (*ii*) abundant experience of doctors, as many of them have already studied and practised medicine abroad.

The idea of medical tourism picked up fast after 1996 and the number of foreign patients seeking treatment or diagnosis in India, with holiday included, increased rapidly. For example, people from West Asia avoided visiting the U.S.A. and European countries for medical treatment after terrorist attack on the U.S.A. on 11th September, 2001 (known as 9/11 attack) and on London (U.K.) on 7th July, 2005 (known as 7/7 attack) and opted for India instead. Besides, value added services such as transfers from the airport, special food for foreigners and translators for patients not conversant with English have given a much needed boost to medical tourism. Realising the potential of health/medical tourism, top hospitals in Delhi and other major cities of India have initiated a new concept of treatment supplemented by vacation. Some hospitals have gone a step forward and are offering the patients and their relatives/friends stay in the hospital complex with all the luxuries of a five star hotel.

Keeping in view the above developments McKinsey had predicted that medical tourism will account for 3 to 5 per cent of the total health care delivery market by 2012. Industry estimates indicate that the market is growing at an average annual rate of about 30 per cent and medical tourism is easily the next big business in India after Information Technology (IT) revolution.

According to PHD Chamber's Medical and Wellness Tourism Report released on July 25, 2014, India is among world's top 5 medical tourism hotspots. As many as 1.66 lakh medical tourists visited India in 2012 and this industry is set to grow to ₹ 36,060 crore by 2018. For details see box.

MEDICAL TOURISTS IN INDIA

- 1,66,000 total number of medical tourists visited India in 2012.
- **From Where**
  1. Asia-Pacific 47.8%, 2. West Asia and North Africa 40.5%, 3. Europe 8.6%, 4. North and South America 2.6%
- **For What**
  1. Cardiology, 2. Cardiothoracic, 3. Orthopaedic, 4. Dentistry, 5. Gastroenterology, 6. Bariatric, 7. Opthalmology and 8. Urology.
- **Globe Trotters**

  Medical tourism as proportion to overall tourism
  1. Thailand 10-11%, 2. Singapore 7-8%, 3. Mexico 4-5%, 4. India 2-3%.

Domestic Tourism

Domestic tourism is an important segment of the overall tourist scenario although no reliable data are available in this regard. It is relatively easy to keep record of foreign tourists as they are registered at entry points like international airports which is not possible in case of domestic tourists. It may be emphasised here that domestic tourism is no less pronounced than the foreign tourism. In fact, domestic tourists far outnumber foreign tourists. This is by far the largest segment of market with a potential of 20 crore local tourists travelling annually. It is domestic tourism which fosters a sense of unity in the otherwise diverse environment of the country and contributes to national integration. Even if 10 per cent of the population travels outside the native state, it involves a massive movement of over 12.5 crore people who develop the feeling that they are travelling within their own country.

Domestic tourism has increased considerably during the last couple of decades. The improved economy and greater exposure through mass media have developed increasing awareness among the people about tourism; a new dimension to their life style. Larger income, longer holidays coupled with certain incentives given by public and private organisations to their workers, have contributed a lot in infusing interest among the hitherto stay-at-home people, to look around for a place for an annual or biannual visit with family members.

Employment Opportunities in Tourism. Tourism in India has vast employment potential, much of which still awaits exploitation. At present about 20.44 million persons are directly employed by hospitality services. This is about 5.6 per cent of the total work force of the country. By 2020, it would

provide 30 million jobs. In addition, the industry provides indirect employment to about 40 million persons. Further, it is interesting to note that the employment generation in proportion to investment is very high in tourist industry. According to one estimate, an investment of ₹ 10 lakh creates 89 jobs in hotel and restaurant sector as against 44.7 jobs in agriculture and 12.6 in manufacturing industries. The ratio further increases if one takes into account the ancillary services associated with hotels and restaurants. Further, it has been estimated that a spend of $ 1 million in this sector supports 407 jobs as compared to communication services (381 jobs), financial services (329 jobs) and manufacturing (315 jobs). Globally, every unit of investment in travel and tourism directly employs six times more than automotive manufacturing industry, five times more than chemical industry, four times more than mining industry and three times more than financial services industry. Another important aspect of employment in tourism is that it employs a large number of women, both educated and uneducated, as well as skilled and unskilled. In fact, women are greater in number than men in hotels, airline services, travel agencies, handicraft making and cultural activities, etc. Tourism is a labour-intensive industry and is likely to offer more jobs in the coming years. And since most of the natural beauty and wildlife are to be found in non-urban areas, rural people could find employment as guides and transporters; with proper training. More jobs in rural areas would also help reduce continuous migration of people to towns.

The Approach Paper of 12th Five Year Plan highlights the need to adopt "pro-poor tourism" for increasing net benefit to the poor and ensuring that tourism growth contributes to poverty reduction. Tourism plays a key role in socio-economic progress through creation of jobs, entreprise, infrastructure and revenue earnings. The Planning Commission has identified tourism as the second largest sector in the country in providing employment opportunities for low skilled workers.

Hotel Accommodation. The hotel sector forms the key segment of tourism industry. Most of the foreign exchange earned by tourist industry is accounted for by hotel segment. Realising the importance of hotel segment, the Government has taken intiatives to encourage hotel indsutry by providing tax benefits and other incentives. The Industrial Policy has now placed the hotels and tourism related activities as a priority industry. Foreign investment and collaborations are now facilitated under the new economic policy.

The Department of Tourism classifies functioning hotels under the *star system* into various categories from one to five-star deluxe and Heritage (Heritage Classic, Grand and Heritage Renaissance) and Apartment Hotels from three star to five star deluxe. The Department also reclassifies these hotels after every five years to ensure that requisite standards are maintained by them. Heritage hotels have been introduced to cover functioning hotels in palaces, *havelies*, castles, forts and residences built

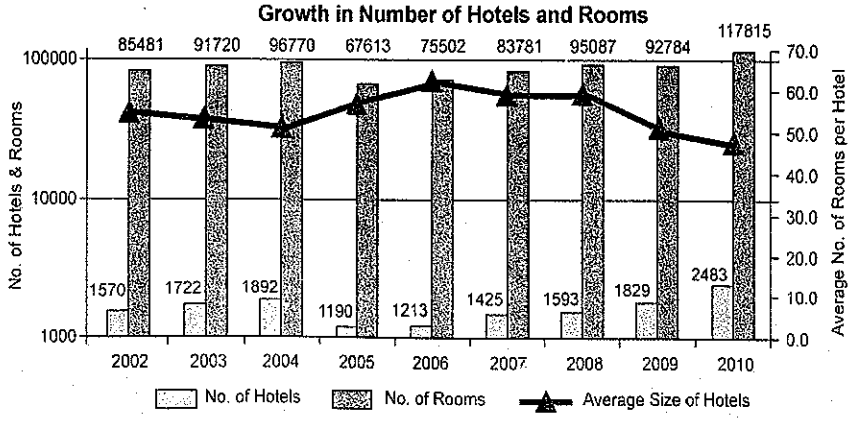

FIG. 28.5. Growth in number of hotels and hotel rooms in India

prior to 1950. Since foreign tourists are crazy about Indian culture and heritage, care has been taken to preserve the original form of the buildings while developing them as heritage hotels. So far, 32 properties have been classified in heritage hotel category providing a room capacity of 972 rooms. Another 38 heritage hotels projects comprising of 710 rooms are in the pipeline. The hotel industry has shown a spectacular growth during the last one decade. Industrial Policy has now placed hotels and tourism related activities as a priority industry. Foreign investment and collaborations are now facilitated under the new economic policy. Automatic approval is available for foreign direct investment (FDI) upto 100 per cent in hotel and tourism sector.

As per information on approved hotels maintained by the Ministry of Tourism, number of rooms increased by 38% in 2010 compared to 2002. while the number of hotels increased by 58% during the same period. It indicates that the average size of the hotels has decreased. This may be in tune with the increasing number of rising middle class budget conscious traveller and growth in demand for that segment.

PLACES OF TOURIST INTEREST

Places of tourist interest are so numerous and of varied nature that it is not easy to describe these places comprehensively. These include places of archaeological and historical importance, pilgrimage centres, sanctuaries and national parks, hill resorts, sea beaches, etc. (**Fig. 28.6**). They are distributed throughout the length and breadth of the country. A brief description of the distribution of tourist places of India is as under :

The Himalayan Region. The Himalayan region is at present, one of the main tourist destinations, not only in India but in the whole of South Asia. Its lofty peaks, snow clad ranges, lush green valleys, turbulent rivers and varied fauna and flora offer a large variety of tourist attractions, games and for skiing, hiking and trekking. The entire length of the Himalayas starting from Jammu and Kashmir in the west to Arunachal Pradesh and Meghalaya in the east is dotted with different types of tourist centres.

Srinagar, Gulmarg, Pahalgam, Patnitop, Jammu, Sonamarg, Amarnath, Vaishno Devi and Leh are the important tourist centres of Jammu and Kashmir. In Himachal Pradesh, there are places like Shimla, Dalhousie, Kangra, Kullu-Manali, Chamba, Kasauli, etc. which attract tourists from far and wide. In the adjoining Himalayan region of Uttarakhand are located famous religious places like Haridwar, Rishikesh, Kedarnath, Badrinath, Gangotri, Yamnotri, Gomukh, etc. Mussoorie, Almora and Nainital are hill stations. The Valley of Flowers presents a unique site in the higher Himalayas. Corbett has the world famous national park.

Towards the east are the famous hill resorts of Darjeeling, Mirik and Kalimpong in West Bengal, Gangtok in Sikkim and Shillong in Meghalaya. Some other places of tourist interest are Kohima in Nagaland, Imphal in Manipur, Aizawl in Mizoram and Agartala in Tripura. At the foothills in Assam are Mannas sanctuary, Soni-Rupa sancturary and Pabha sanctuary for protection of animals like one horned rhinoceros, wild buffaloe, etc.

The Great Plain of North India. Although monotonous from the view point of relief, this vast plain extends from the sandy stretches of Rajasthan in the west to the Sundarbans in the east and possesses a large number of tourist places. These places are of historical, archaeological, religious and industrial importance. It includes large parts of Rajasthan, Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal and Assam, besides the union territories of Delhi and Chandigarh.

The whole of Rajasthan is famous for its palaces, forts, religious places and above all the vast stretches of sand dunes. More than half of the state to the west of the Aravali Range forms part of the Great Plain of North India. Here, Jaisalmer has become very popular during the recent years. Along with Jodhpur and Bikaner, it forms the famous **desert triangle**. In Punjab, Amritsar is an important seat of sikh religion. Jalandhar, Ludhiana, Patiala, Bhatinda and Sirhind are other tourist centres of Punjab. Haryana Tourism has developed several places as tourist centres. They include Ambala, Kurukshetra, Karnal, Panipat, Pinjour, Morni, Pehowa and Faridabad. Surajkund near Faridabad has become famous all over India due to its *annual crafts mela*. Delhi is the capital of the country and represents India in miniature. It has almost all sorts of tourist attractions including historical and administrative buildings, religious

places, museums, parks and gardens, art galleries, etc. Chandigarh, the city beautiful, is one of the few planned cities of India. It is well known for its world famous rock garden, rose garden and Sukhna lake.

The plains of Uttar Pradesh present a grand mixture of Hindu and Islamic cultures. Mathura, Vrindaban, Allahabad, Varanasi, Ayodhya, Sarnath are the sacred cities of Hindu religion. Lucknow,

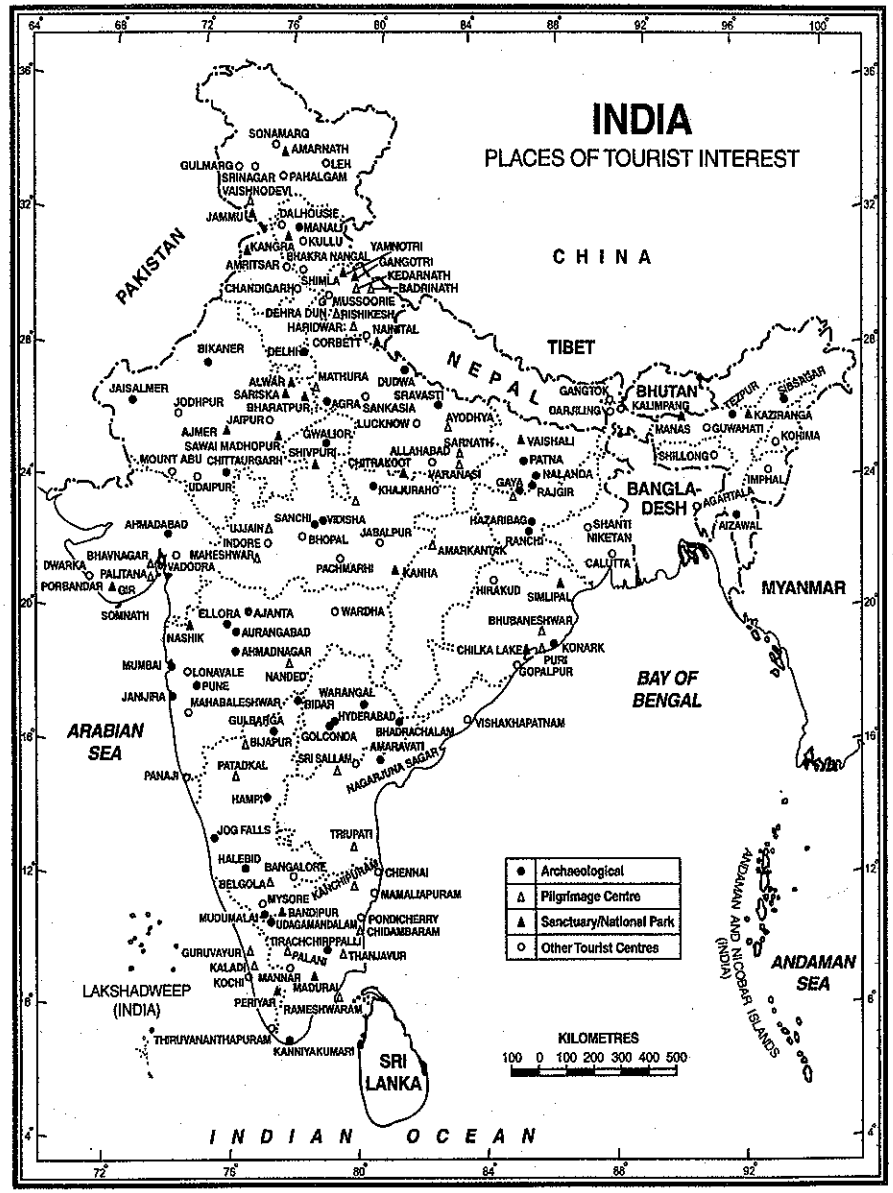

FIG. 28.6. India : Places of Tourist Interest

Agra and Aligarh represent Islamic religion, culture and history. Sarnath is an important Buddhist religious centre. Agra is known for its world famous Taj Mahal. Any foreign tourist who visits Delhi makes it a definite point to visit the Taj at Agra. As a matter of fact, Delhi, Agra and Jaipur form the world famous **Golden Triangle**. In the Bihar Plain are located Patna, Nalanda, Vaisali, Munger and Sitamarhi. In West Bengal, Kolkata is the most important place. This is the capital of West Bengal and is the second largest metropolitan city of India, after Mumbai. Kolkata is often called the nerve centre of the entire eastern region. Shanti Niketan is famous for being the work place of Nobel laureate Gurudev Rabindranath Tagore. Sundarbans, the abode of the Royal Bengal Tigers offers much to the tourists. Murshidabad, Malda and Bishnupur are historical centres. In the Assam plain are located Barpeta, Hajo, Tejpur, Sibsagar and Guwahati. Besides, Orang, Ladkhowa, Golaghat and Kaziranga have wild life sanctuaries.

The Peninsular Plateau and the Coastal Plains. This is a vast area with varied types of physical and cultural landscape and offers wide choice to the tourists. It encompasses a large number of states like Gujarat, Maharashtra, Goa, Madhya Pradesh, Chhattisgarh, Jharkhand, Odisha. Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Kerala and the union territories of Puducherry, Daman and Diu and Dadra and Nagar Haveli. Besides it includes eastern parts of Rajasthan extending upto Aravali range.

In **Rajasthan** there are several places of tourist interest along the Aravali range and in areas to the east of this range. These include Jaipur, Ajmer, Chittaurgarh, Udaipur, Mount Abu, Alwar, Sariska, Bharatpur, Dholpur, Bundi, Ranthambhor, Sawai Madhopur and many more.

Gujarat was ruled by princely states and is dotted by places of historical and cultural significance. Some of the important towns of this type are Vadodara, Rajkot, Jamnagar, Bhavnagar and Junagadh. Somnath and Dwarka are important places of Hindu religion. Palitana is the sacred hill of Jains. Porbander is famous for being the birth place of Mahatma Gandhi. Gir forest is the sanctuary for lions, the only one of its kind in India. Ahmedabad is an important industrial and archaeological centre.

Maharashtra is very rich in tourist resorts. The state has the world famous Ajanta, Ellora and Aurangabad Caves. There are about 1,545 caves created in India by followers of Buddhist-Hindu and Jain creed, out of which more than 1,200 caves are clustered in Deccan Trap formation of Western Maharashtra. Panchaghani, Mahabaleshwar, Khandala, Lonavala and Matheran are important hill stations on the Western Ghats. The important among the cultural, historical and religious centres are Pune, Nagpur, Nashik, Kolhapur, Aurangabad, Ahmadnagar, Shirdi, Nanded, Wardha and Melghat. Above all, Mumbai is the commercial capital of India and offers several opportunities to tourists.

Goa is a picturesque land full of scenic beauty and abounding places of tourist interest. Tourism forms a major segment of Goa's economy, contributing over 16 per cent of the total earnings of the state. About 20 per cent Goans earn their livelihood directly and indirectly through tourism. Nowhere in India, a tourist will find such a large number of tourist places, in such a small area as in Goa. Goa's forts, churches, temples, evergreen hills, winding rivers, bays, creeks and above all the pearl white palm fringed beaches would leave any visitor to the state spell bound. Goa has more beaches than any other state of comparable size. Among the important beaches are Anjuna, Calangute, Kolva, Vagator, Kandoli, Betul and Palolen. The Western Ghats just touch the coast giving this area a unique combination of sea and hill topography of scenic beauty.

Madhya Pradesh is the state with varied landforms and a unique mixture of Indo-Aryan and the aboriginal cultures. As many as 125 places with potential for tourist attraction have been identified, out of which 16 major tourist places have been taken into account for development to attract foreign tourists. They include places of different varieties such as historical and archaeological (Gwalior, Mandu, Khajuraho, Orchha, Sanchi, Udaigiri, Gyaraspur), natural setting (Marble rocks, Pachmarhi), religious (Amarkantak, Chitrakoot, Maheshwar, Ujjain) and wildlife (Bandhavgarh National Park, Kanha National Park and Shivpuri National Park). In *Chhattisgarh*, most of the places of tourist interest are in Bastar area.

The **Chota Nagpur** plateau of Jharkhand is a combination of mineral wealth, cultural heritage and natural beauty. Ranchi, Gunha, Dumka, Jamshedpur, Dhanbad, etc. are the main centres of tourist interest.

Odisha has several tourist centres. The major centres are Puri, Bhubaneshwar, Cuttack, Konarka, Chilka lake and Gopalpur beach. The other places are Baripada, Khiching, Bauda, Koraput, Bolangir, Jajpur and Udayagiri.

Andhra Pradesh and Telangana attract large number of tourists, both foreign and domestic, for its historical places like Hyderabad, Golconda Fort and Warangal and relgious centres like Tirupati, Tirumala, Sri Kalahasti, Sri Sailam, Mahanadi and Mukhalingapuram. Besides, there are other tourist centres like Nagarjuna Sagar, Kolleru and Mangunapudi.

Karnataka is famous for its gardens, historical and religious places and natural beauty spots. The Brindavan Garden near Mysore could be the envy of any beautiful garden in the world. Bengaluru, the garden city, is the capital of the state and is famous for many industries. Some of the important historical and religious centres are Mysore, Bijapur, Gulbarga, Bidar, Nandi Hill, Shravan Belgola, Shrirangapattam, Chamundi, Belur, Halebid, Chitradurga, etc. Ranganthitto bird sanctuary, Bandipur and Dendilio wildlife sanctuary, Jog Falls on Sharavati river along with Madog Falls and Lushington falls and the beaches of Murudesvar, Maravanthe, Malpe, etc. are the other major tourist attractions.

Tamil Nadu is famous for its renowned temples at Rameshwaram, Madurai, Thanjavur, Tiruchchirappalli, Tiruvannamalai, Kanchipuram, etc. The state also boasts of famous hill stations like Udagamnadlam (Ooty). Kodaikanal, Coonoor and Yercaued. The capital city of Chennai with its Marina beach and Golden beach and several religious and historical buildings, is a great tourist attraction. Kanniyakumari is the southern-most tip of the mainland of the country where waters of Arabian Sea, Bay of Bengal and Indian Ocean merge with one another. It is world famous for its Rock Memorial. Mudumalai, Anaimalai and Mundanthurai have wildlife sanctuaries.

Kerala is not lagging behind with respect to tourism. The state is blessed with several places having buildings of historical and architectural importance, beautiful sea beaches, wildlife sanctuaries and some hill resorts. The main places of tourist interest are Thiruvananthapuram, Kochi, Alappuzha, Kannur, Thrissur, Kozhikode, Ernakulam, Malayatoor, Idukki, Periyar, Munnar, Thekdi, etc.

Among the union territories, Puducherry has the famous Aurobindo Ashram along with some other places of historical and religious importance. Daman and Diu on the Arabian Sea coast have a beach and some religious and historical places.

Islands. India has two groups of islands. They are having picturesque landscape and are fast becoming major tourist attractions. The Andaman and Nicobar Islands in the Bay of Bengal have beautiful beaches, lush green tropical rain forests and a vast variety of oceanic life in the blue seas surrounding them. Port Blair is the main tourist spot. The Lakshadweep group of islands is of coral origin and attracts tourists from far and wide.

PROBLEMS AND PROSPECTS

Although India has progressed a lot since 1950s with respect to tourism, she is still way behind the developed or even the developing countries. India's share in the tourist arrival has been growing at a snails pace from 0.23 per cent in 1975 to 0.28 per cent in 1980 and 0.42 per cent in 2004. Even now, it is less than one per cent of the world tourist arrivals and is much less than he other South Asian countries like Singapore, Malaysia, Thailand, Hong Kong, Macao, etc. Even the diminutives like Maldives and Bhutan present an appreciable model of sustainable tourism by integrating environment and tourism. In India, tourism provides 5.6 per cent of the total jobs, China that just pulled away its iron curtain, is doing better with 7 per cent. Torn apart by civil war Sri Lanka still has 7.4 per cent of its jobs coming from the tourism sector. Travel is a happening business in Thailand, generating 11.2 per cent of the total jobs.

Still there are large areas which are untapped from the tourist point of view. Traditionally a popular destination, North India still draws about 49 per cent of the tourists; whereas only 4 per cent go to east. West is doing better getting 29 per cent of the tourist inflow. South, despite its beaches, temples, hills, etc. gets only 18 per cent of foreign and domestic tourists. Thus there is great potential for development of

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