CLASSROOM STUDY MATERIAL

GEOGRAPHY

Part - 4

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GEOGRAPHY PART 4

Student Notes:

DIFFERENT TYPES OF IRRIGATION AND IRRIGATION SYSTEMS

Contents

Getting an irrigation system is easy, but getting the most efficient irrigation system for your needs can be quite a bit harder.

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1. Irrigation and Benefits of Irrigation

The process of supplying water to crops by artificial means such as canals, tube wells, tanks etc. is known as irrigation. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dryland farming.

Mankind is getting benefits of irrigation system since ancient time. Archaeological investigation has identified evidence of irrigation where the natural rainfall was insufficient to support crops. For example, **Perennial irrigation** was practiced in Mesopotamian plains, **Terrace irrigation** in Syria, Basin irrigation in Egypt etc. With the advent of diesel and electric motors in 20th century, humans increased the area under irrigation by pumping more and more ground water and extending the canals etc.

In greater part of India, agriculture is rain-fed. In the incidence of failure of monsoon, the crop fails. The behavior of Indian monsoon is highly erratic. Excess rainfall may cause floods, but scanty rainfall may reduce the crop yield substantially, and in acute cases the crop may be a complete failure.

India has very large population and it is estimated that India needs more than 450 million tonnes of grain to meet the demand of growing population. Climate change will result into more instances of erratic climatic conditions and thus, crops are more prone to high variability in rain. The present productivity of irrigated land is about 2.5 tonnes/hectare and less than 0.5 tonnes/hectare for rainfed lands. In this context, there is an urgent need to implement and plan irrigation strategies.

India possesses 4% of the total average annual run off in the rivers of the world. The per capita water availability of natural run off is at least 1100 cubic meters/yr. The amount of water that can actually be to put to beneficial use is much less due to severe limitations imposed by physiographic, topographic, interstate issues and the present technology to harness water resources economically.

Benefits of irrigation

- **Increase in crop yield**: the production of almost all types of crops can be increased by providing the right amount of later at the right time, depending on its shape of growth. Such a controlled supply of water is possible only through irrigation.
- **Protection from famine:** the availability of irrigation facilities in any region ensures protection against failure of crops or famine due to drought. In regions without irrigation, farmers have to depend only on rains for growing crops and since the rains may not provide enough rainfall required for crop growing every year, the farmers are always faced with a risk.
- **New areas under cultivation:** irrigation brings new areas under cultivation and increases the net area under irrigated cultivation.
- **Cultivation of superior crops:** with assured supply of water for irrigation, farmers may think of cultivating superior variety of crops or even other crops which yield high return. Production of these crops in rain-fed areas is not possible because even with the slight unavailability of timely water, these crops would die and all the money invested would be wasted.
- **Elimination of mixed cropping**: in rain-fed areas, farmers have a tendency to cultivate more than one type of crop in the same field such that even if one dies without the required amount of water, at least he would get the yield of the other. However, this reduces the

overall production of the field. With assured water by irrigation, the farmer would go for only a single variety of crop in one field at anytime, which would increase the yield.

- **Economic development**: with assured irrigation, the farmers get higher returns by way of crop production throughout the year, the government in turn, benefits from the tax collected from the farmers in base of the irrigation facilities extended.
- **Hydro power generation**: usually, in canal system of irrigation, there are drops or differences in elevation of canal bed level at certain places. Although the drop may not be very high, this difference in elevation can be used successfully to generate electricity. Such small hydro electric generation projects, using bulb-turbines have been established in many canals, like Ganga canal, Sarada canal, Yamuna canal etc.
- **Domestic and industrial water supply**: some water from the irrigation canals may be utilized for domestic and industrial water supply for nearby areas. Compared to the irrigation water need, the water requirement for domestic and industrial uses is rather small and does not affect the total flow much. For example, the town of Siliguri in the Darjeeling district of West Bengal, supplies its residents with the water from Teesta Mahananda link canal.

2. Classification of Irrigation Schemes

Due to difference in topology, water availability, land availability, feasibility of technology etc., different irrigation technologies exist in the world. Irrigation system is classified under various schemes as discussed below:

2.1. Based on Sources

Depending on the availability of surface and underground water, slope of land, nature of the soil and the types of crops grown in a region, a number of sources of irrigation are utilized. The main sources of irrigation used in different parts of the country are (figure 1):

- Wells and tube-wells
- Canals
- tanks
- other sources – springs, kuhls, dhenkli, dongs and bokka

2.1.1. Well and Tube-Wells

This type of irrigation is practiced since ancient time. It accounts for 62 per cent of the total irrigated area of the country. It is the easiest source of irrigation. It can be installed in a short duration of time. It is however expensive and diminishes the underground water-table, if exploited in unsustainable manner. The largest area under tube-well irrigation is in Uttar Pradesh followed by Rajasthan, Punjab, Madhya Pradesh, Gujarat, and Bihar.

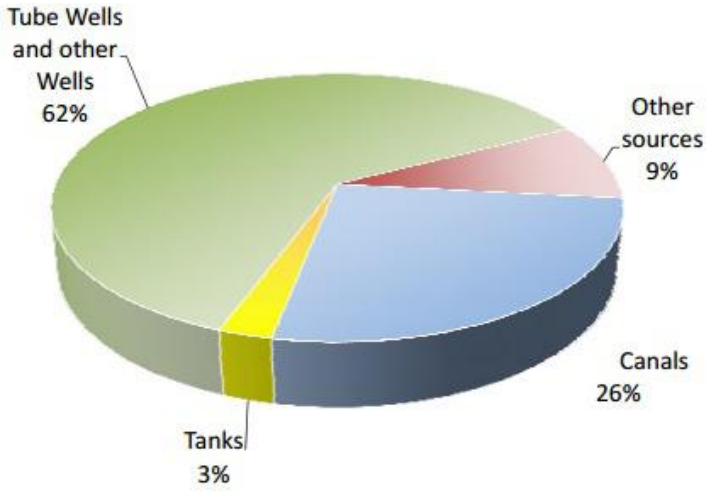

Figure 1: Net Area under irrigation by sources (2009-10)

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2.1.2. Canal

Canal used to be the main source of irrigation in 1950-51, irrigating almost 50 per cent of the total irrigated area of India. In 1960s, there was a tremendous increase in the tube-well irrigated area promoted by the government. Consequently, the percentage of canal irrigated area declined to less than 40 per cent and in 2009-10, it is only 26 per cent.

Canals are an effective in low and leveled relief, productive plain areas where perennial source of surface drainage is available. These conditions are ideally found in the Northern plains of India, Kashmir and Manipur valleys and the Eastern Coastal plains (figure 2). High density of canals is found in Uttar Pradesh with Ganga canal system, Punjab, Haryana and Western Rajasthan with Indira Gandhi Canal. In Peninsular region, Damodar, Mahanadi, Godavari, Krishna, Narmada rivers etc. rivers have important canal system. Uttar Pradesh has the first rank in canal irrigation followed by Andhra Pradesh.

2.1.3. Tank

An **irrigation tank** or **tank** is an artificial reservoir of any size. It can also have a natural or man-made spring included as part of a structure. In some parts of the country, especially in the peninsular India tank is an important source of irrigation. About 3 per cent of the total irrigated area is under tank irrigation.

According to the third minor irrigation census carried out in 2000-01, there are about 5.56 lakh tanks in the country, with the most occurring in the following states:

- West Bengal: 21.2 per cent of all the tanks in the country
- Andhra Pradesh: 13.6 per cent
- Maharashtra: 12.5 per cent
- Chhattisgarh: 7.7 per cent
- Madhya Pradesh: 7.2 per cent
- Tamil Nadu: 7.0 per cent
- Karnataka: 5.0 per cent

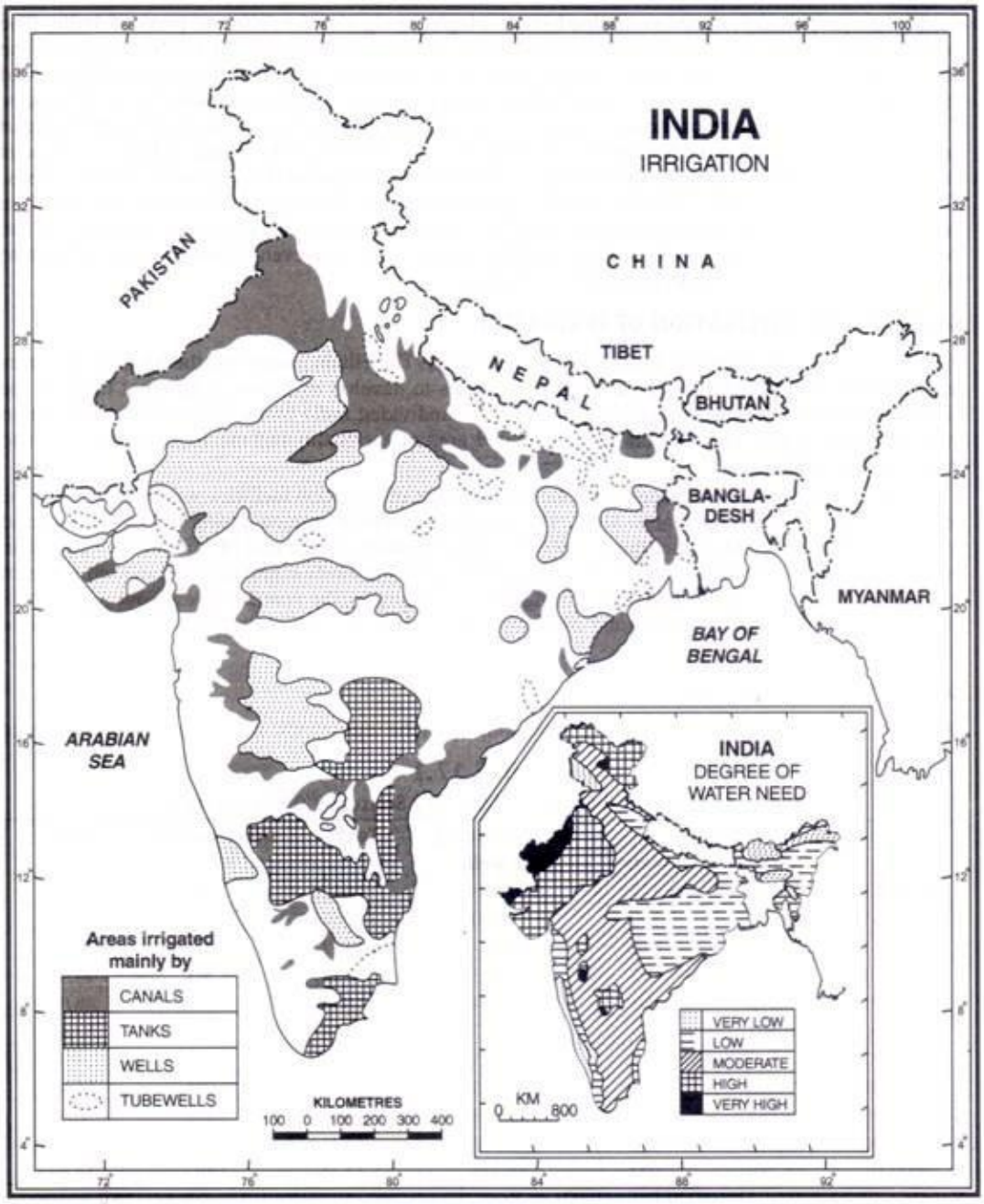

Figure 2: India – Source of irrigation

Many of the tanks, however, dry up during the summer season when more irrigation is required. Due to non-use of these 15 percent tanks nearly 1 M-ha of Irrigation potential is lost. Another, around 2 M-ha of potential is lost due to under utilisation of tanks in use. Loss of potential due to non use is more pronounced in Meghalaya, Rajasthan and Arunachal Pradesh (above 30%), whereas loss of potential due to under utilisation is more than 50 percent in case of Gujarat, Nagaland, Rajasthan, A&N Island and Dadar and Nagar Haveli.

2.2. Based on Magnitude

Irrigation Projects in India are classified into three categories on the basis of Culturable command area (CCA) [1] as:

- **Major** - Projects which have a **CCA of more than 10,000** hector are termed as Major Projects.
- **Medium** - Irrigation Projects which have a **CCA of less than 10,000 hector but more than 2,000** hector are termed as Medium projects

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- **Minor Irrigation** - those Irrigation Projects which have a **CCA of 2,000 hector or less** are known as Minor projects.

The ultimate irrigation potential of the country from major and medium irrigation projects has been assessed as about 64 M-ha. For the country as a whole, 66% of it has been created. The average rate of creation of irrigation potential through Major and Medium projects from 1951 to 1997 has been found to be of the order of 0.51 Million hectare per year. During the year 1997 to 2005, the rate for creation has been found to be 0.92 Million hectare per year. This increase in pace is probably due to fruition of projects started much earlier, which have been expedited due to increased support through AIBP(Accelerated Irrigation Benefit Programme).

Minor irrigation projects have both surface and ground water as their source, while Major and Medium projects mostly exploit surface water resources. Ground water minor irrigation is primarily done through individual and cooperative effort of farmers with the help of institutional finance and their own savings. Surface water minor irrigation schemes are generally funded from the public sector only. The ultimate irrigation potential from minor irrigation schemes have been assessed as 75.84 million ha of which partly would be ground water based (58.46 million ha) and covers about two thirds. By the end of the ninth plan, the total potential created by minor irrigation was 60.41 million ha.

Minor irrigation schemes contribute a major share in the growing irrigation across the country accounting for about 65% of the total irrigation potential utilized. The Minor irrigation scheme has been categorized broadly into five major types, namely:

1. Dugwell
2. Shallow tubewell
3. Deep tubewell
4. Surface flow schemes
5. Surface lift schemes

2.2.1. Major and Medium vis-à-vis Minor Irrigation Projects

While formulating strategies for irrigation development the water resources planner should realize the benefits of each type of project based on the local conditions. For example, it may not always be possible to benefit remote areas using major/medium projects. At these places minor irrigation schemes would be most suitable. Further, land holding may be divided in such a way that minor irrigation becomes inevitable. However, major and medium projects wherever possible is to be constructed to reduce the overall cost of development of irrigation potential.

2.3. Based on Technique of Distribution of Water

Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little. The various irrigation techniques are as under:

- **Surface Irrigation:** In surface irrigation systems, water moves over and across the land by simple **gravity flow** in order to wet it and to infiltrate into the soil. It is often called **flood irrigation** when the irrigation results in flooding or near flooding of the cultivated land. Surface irrigation can be subdivided into:
    - **Basin irrigation** has historically been used in small areas having level surfaces that are surrounded by earth banks (figure 3). The water is applied rapidly to the entire basin and is allowed to infiltrate. Basins may be linked sequentially so that drainage from one basin is diverted into the next once the desired soil water deficit is satisfied.
    - **Furrow irrigation** is conducted by creating small parallel channels along the field length in the direction of predominant slope (figure 4). Water is applied to the top end of each furrow and flows down the field under the influence of gravity.

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- **Border strip**, otherwise known as border check or bay irrigation could be considered as a hybrid of level basin and furrow irrigation. The field is divided into a number of bays or strips; each bay is separated by raised earth check banks (borders). The bays are typically longer and narrower compared to basin irrigation and are orientated to align lengthwise with the slope of the field.

Figure 3: Basin irrigation

Figure 4: Furrow irrigation using siphon tubes

- **Localized Irrigation**: Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre- determined pattern, and applied as a small discharge to each plant or adjacent to it. It is also known as **low-flow irrigation system/low volume irrigation/micro-irrigation**. **Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation** belong to this category of irrigation methods.
  - **Drip Irrigation**: Drip irrigation, also known as **trickle irrigation**, functions as its name suggests (figure 5). Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water- efficient method of irrigation, if managed properly, since evaporation and runoff are minimized. The field water efficiency of drip irrigation is 80 to 90 percent. In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation, and is also the **means of delivery of fertilizer**. This is known as **fertigation**.

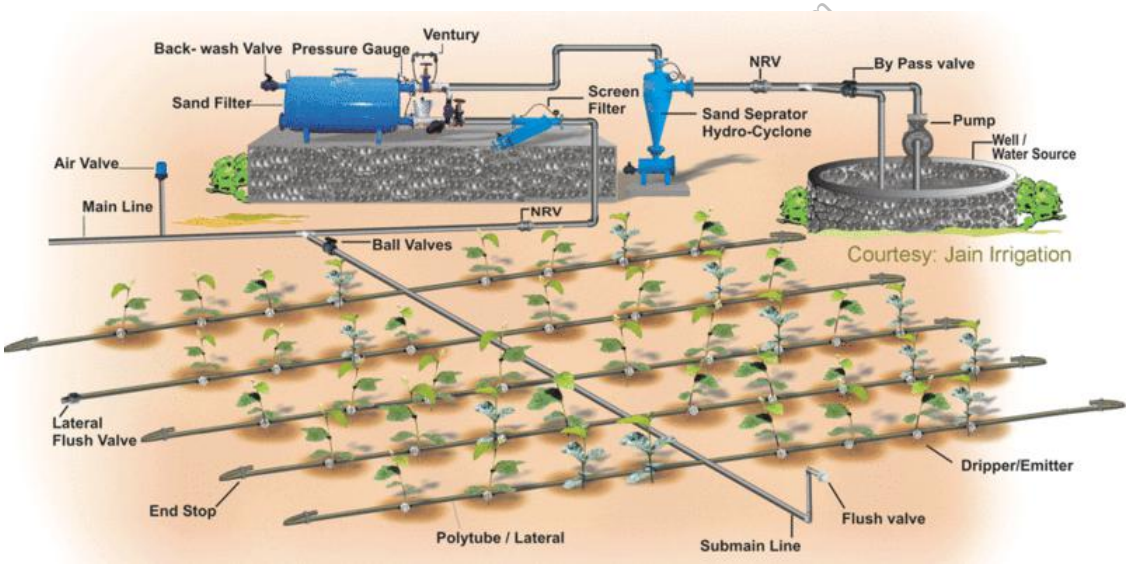

Figure 5: Drip Irrigation system

  - **Sprinkler Irrigation**: In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns (figure 6). A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a **solid-set irrigation system**. Higher pressure sprinklers that rotate are called rotors and are driven by a ball drive, gear drive,

or impact mechanism. Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging. Sprinklers can also be mounted on moving platforms connected to the water source by a hose. Automatically moving wheeled systems known as **traveling sprinklers** (figure 7) may irrigate areas such as small farms, sports fields, parks, pastures, and cemeteries unattended. The field water efficiency of sprinkler irrigation is 60 to 70%.

Figure 6: Sprinkler irrigation

Figure 7: Travelling Sprinkler irrigation

- **Sub-irrigation**: Sub-irrigation also sometimes called **seepage irrigation** has been used for many years in field crops in areas with high water tables. It is a method of artificially raising the water table to allow the soil to be moistened from below the plants' root zone. Often those systems are located on permanent grasslands in lowlands or river valleys and combined with drainage infrastructure. A system of pumping stations, canals, weirs and gates allows it to increase or decrease the water level in a network of ditches and thereby control the water table. Sub-irrigation is also used in commercial greenhouse production, usually for potted plants. Water is delivered from below, absorbed upwards, and the excess collected for recycling. Three basic types of sub-irrigation are: **ebb-and-flow, trough, and flooded floor**.

There are various **challenges** to adopt these localized forms of irrigation. Few of them are listed below:

- **Expense**: initial cost can be more than overhead systems.
- **Waste**: the sun can affect the tubes used for drip irrigation, shortening their usable life.
- **Clogging**: if the water is not properly filtered and the equipment not properly maintained, it can result in clogging.
- **Waste of water, time and harvest,** if not installed properly. These systems require careful study of all the relevant factors like land topography, soil, water, crop and agro-climatic conditions, and suitability of drip irrigation system and its components.

2.4. Based on the Way the Water is Applied

The classification of the irrigation systems can also be based on the way the water is applied to the agricultural land as:

- **Flow irrigation system**: where the irrigation water is conveyed by growing to the irrigated land. This may again be classified into the following.
  - **Direct irrigation**: Where the irrigation water is obtained directly from the river, without any intermediate storage. This type of irrigation is possible by constructing a weir or a barrage across a river to raise the level of the river water and thus divert some portion of the river flow through an adjacent canal, where the flow takes place by gravity.
  - **Reservoir/tank/storage irrigation**: The irrigation water is obtained from a river, where storage has been created by construction an obstruction across the river, like a dam. This ensures that even when there is no inflow into the river from the catchment, there is enough stored water which can continue to irrigate fields through a system of canals.

- **Lift irrigation system**: Where the irrigation water is available at a level lower than that of the land to be irrigated and hence the water is lifted up by pumps or by other mechanical devices for lifting water and conveyed to the agricultural land through channels flowing under gravity. For instance, a large portion of Indira Gandhi canal in Rajasthan is fed by lift irrigation system.

2.5. On the Basis of Duration of the Applied

Classification of irrigation systems may also be made on the basis of duration of the applied water, like:

- **Inundation/flooding type irrigation system:** In which large quantities of water flowing in a river during floods is allowed to inundate the land to be cultivated, thereby **saturating the soil**. The **excess water is then drained off** and the land is used for cultivation. This type of irrigation uses the flood water of rivers and therefore is limited to a certain time of the year. It is also common in the areas near river deltas, where the slope of the river and land is small. Unfortunately, many of the rivers, which were earlier used for flood inundation along their banks, have been embanked in the past century and thus this practice of irrigation has dwindled.
- **Perennial irrigation system**: In which irrigation water is supplied according to the crop water requirement at regular intervals, throughout the life cycle of the crop. The water for such irrigation may be obtained from rivers or from walls. Hence, the source may be either surface or ground water and the application of water may be by flow or lift irrigation systems.

2.6. Choice of Irrigation Method

As we have discussed above, there are various ways to provide water to crops. However, choosing right kind of method is a challenge. It must suit the particular crop, soil and of course, depends on availability of water. For example, following is a short list of available methods corresponding to the kind of crop.

Method	Suitable for crops
Border Strip method	Wheat, Leafy vegetables, Fodders
Furrow method	Cotton, Sugarcane, Potatoes
Basin method	Orchard trees

Table 1: Irrigation method for different crops

Other methods like sprinkler and drip irrigation systems are adapted where water is scarce and priority for its conservation is more than the consideration for cost. Although most advanced countries are adopting these measures, they have not picked up as much in India mainly due to financial constraints. However, as time passes and land and water resources get scarce, it would be essential to adopt these practices in India, too.

3. Efficiency

Irrigation efficiency is defined as the ratio between the water stored in the soil depth inhabited with active plant roots to the water applied by the irrigation system. Thus, water applied by the irrigation system and not being made available to be taken up by plant roots is wasted and reduces irrigation efficiency. The major **causes** for reduced irrigation efficiency **are drainage of excess irrigation water** to soil layers deeper than the depth of active roots. **Leakage of irrigation water to deep soil layers** could result in pollution of the water table. Over-irrigation and under-irrigation, both are injurious to the crop. Thus, the timings of irrigation and the quantity of water supplied are decisive for the satisfactory performance of the crop. In the case of wheat for example, appropriate timing and spacing of irrigation raise the yield as much as 50 per cent with less use of water.

The cases of irrigation efficiency of 100 percent are practically none existent even in the most modern irrigation systems. Major difficulties in obtaining high irrigation efficiency stems from the

inability to obtain an accurate estimate of the quantity of water needed to recharge the soil root zone depth and the lack of valid, real time information concerning the actual soil depth of active roots.

Conservative estimates suggest that even under optimal management practices the average irrigation efficiency is estimated to be 70 percent. Thus, the average water loss under sprinkler and drip irrigation is 30 percent but could drop to values of over 50 percent under furrow and flood irrigation. Efficiency of drip irrigation can reached to 90 per cent with best efforts. Water losses of irrigation water under urban and landscape irrigation could easily reach 50 percent of the applied water.

India's national water mission aims to increase water use efficiency by 20 per cent. Agriculture contributes for more than 80 per cent of water usage in the country. Therefore, a large focus of the mission is on the improving efficiency of various irrigation projects such as Major & minor irrigation schemes, CAP&WM (Command Area programmme & Water Management), and AIBP (Accelerated Irrigation Benefits Programme) etc.

4. Irrigation and National Water Policy

India had adapted a national water policy in the year 1987 which was revised in 2002. The policy document lays down the fact that planning and development of water resources should be governed by the national perspective. Certain aspects of policy related to irrigation are quoted below:

- Irrigation planning either in an individual project or in a watershed as a whole should take into account the irrigability of land, cost-effective irrigation options possible from all available sources of water and appropriate irrigation techniques for optimizing water use efficiency. Irrigation intensity should be such as to extend the benefits of irrigation to as large a number of farm families as possible, keeping in view the need to maximize production.
- There should be a **close integration of water use and land use policies.**
- Water allocation in an irrigation system should be done with due regard to equity and social justice. Disparities in the availability of water between head-reach and tail end farms and between large and small farms should be obviated by adoption of a rotational water distribution system and supply on a volumetric basis subject to certain ceilings and rational pricing.
- Concerted efforts should be made to ensure that the **irrigation potential created is fully utilised**. For this purpose, the command area development approach should be adopted in all irrigation projects.
- Irrigation being the largest consumer of fresh water, the **aim should be to get optimal productivity per unit of water**. Scientific management farm practices and sprinkler and drip system of irrigation should be adopted wherever feasible.
- **Reclamation of water-logged/saline affected land** by scientific and cost effective methods should form a part of command area development programme.

5. Command Area Development and Water Management (CADWM)

The planned development of irrigation sector started in a big way since the First Five Year Plan (1951–56). New projects were taken up in the Second Five Year Plan, the Third Five Year Plan, and the Annual Plans 1966–69. During the Fourth Five Year Plan emphasis was shifted to the completion of ongoing schemes.

The widening gap between potential creation and utilization was felt in the Fifth Plan (1974– 78) and accordingly Command Area Development programme (CADP) was launched as a Centrally-sponsored scheme in 1974-75. The CADP is an integrated area development approach towards the command areas of major and medium irrigation projects in the country. The programme is

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aimed at bridging the gap between created irrigation potential and its utilization in the command area.

The CAD programme was initially introduced in the Indira Gandhi Canal Command Area in 1974. Up to March 1998 the total number of projects taken up for command area development increased to 217 with cultivable command area (CCA) of 21.78 million hectares and spreading over 23 states and 2 union territories.

This programme was restructured and renamed as Command Area Development and Water Management (CADWM) Programme since April 1, 2004. The scheme is now being implemented as a State sector scheme during the XI Five Year Plan (2008-09 to 2011-12). During the XII Plan, the Scheme is to be implemented *pari-passu* with Accelerated Irrigation Benefits Programme (AIBP). The total proposed outlay for the XII Plan (Central share) is Rs.15,000 crore to cover about 7.6 Mha.

The Programme involves execution of on- farm development works like construction of Field channels and Fields drains, land leveling and shaping and conjunctive use of surface and ground-water. Warabandi or the rotational system of water distribution is undertaken with a view to ensuring equitable and timely supply of water to the farmers. Attention is also given to diversification of crore pattern so that water is put to optimum use and productivity of land increased. During such diversion Frication emphasis would be given to the production of oil seeds, pulses etc to eliminate as far as possible their shortage.

Under the CAD programme, the Ministry of Water Resources is also introducing and promoting participatory irrigation management (discussed below) in the CAD Projects by creating awareness and providing financial assistance to farmers' associations. Reclamation of waterlogged areas in irrigated commands is also an important component of the Programme.

An area of about 20.149 Mha has been covered under the programme since inception up to end of March, 2012.

6. Participatory Irrigation Management (PIM)

Any irrigation project cannot be successful unless it is linked to the stakeholders, that is, the farmers themselves. In fact, people's participation in renovation and maintenance of field channels was the established practice during the pre-independence days. However, the bureaucracy encroached on this function in the post-independence period and a realization has dawned that without the participation of farmers, the full potential of an irrigation scheme may not be realized.

The concept of involvement of farmers in management of the irrigation system has been accepted as a policy of the Government of India and has been included in the National Water Policy adopted in 1987. It stated that

> "*Efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating the farmers in efficient water-use and water management.*"

Policy guidelines were framed for farmers' participation in the areas under the Centrally Sponsored Command Area Development Programme. One of the objectives of PIM is to create a sense of ownership of water resources and the irrigation system among the users, so as to promote economy in water use and preservation of the system.

At operational level, Water **Users' Association (WUA), Distributary Committee and Project Committees** have been formed. With the help of a model act by central government, various states have enacted laws for PIM. Total area covered under various WUA in all states together is approximately 15 million hectare in 2010.

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7. Accelerated Irrigation Benefits Programme (AIBP)

The government of India launched Accelerated Irrigation Benefits Program (AIBP) in 1996-97. This program was launched to give loan assistance to the states to help them a few major irrigation projects which were in advanced stage of completion. The advanced stage of construction would imply that

- At least 50% of latest approved estimated project cost already incurred and
- At least 50% of physical progress of essential works of the project has taken place; and
- The proposal of the State for inclusion of project under AIBP must be supported by a credible construction schedule indicating the works already executed and works to be executed along with their costs.

In this program major, medium and Extension, Renovation & Modernization (ERM) irrigation projects which were having investment clearance of Planning Commission and were in advanced stage of construction and can be completed in the next four financial year and also were not receiving any other form of financial assistance were considered for inclusion in the programme.

The State Governments have been provided an amount of Rs.43425.6331 crore as CLA/Grant under AIBP since inception of this programme till 1.12.2010 for 283 major/medium irrigation projects and 11655 Surface minor irrigation schemes. After commencement of this Programme 129 major/medium projects and 7969 Surface major/medium irrigation Schemes have so far been reported completed. An additional irrigation potential of 59.39 lakh hectare has been created up to March 2009.

8. Repair, Renovation and Restoration of Water Bodies Scheme

In India, tanks/ponds and lakes have traditionally played an important role in conserving water for meeting various needs of the communities. Minor irrigation sources (tanks etc.) have 6.27 million ha. of irrigation potential. Around 15-20 per cent sources are not in use for one reason or the other, as a result of which one million ha of irrigation potential has been lost. Another, around 2 M-ha of potential is lost due to under utilisation of tanks in use.

The Government of India sanctioned a Pilot Scheme for "**National Project for Repair, Renovation & Restoration (RRR) of Water Bodies directly linked to Agriculture**" in January, 2005. Financial share of centre and state is in ration of 3:1. The objectives of the Scheme were to restore and augment storage capacities of water bodies, and also to recover and extend their lost irrigation potential. In its pilot phase, irrigation potential for 1.73 lakh hectare was realized.

With the success of pilot scheme, scheme has been extended for twelfth five year plan. It is envisaged to take up RRR works in 10,000 water bodies with a Central Assistance of Rs. 6235 crore. Out of 10000 water bodies, 9000 water bodies are proposed to be in rural areas and balance 1000 water bodies will be in urban areas. The proposal of water bodies where the Integrated Water Management Programme (IWMP) is implemented would be considered to be included under the scheme RRR of water bodies. At gram panchayat level, water users' associations (WUA) are responsible for detail project report and implementation. There are corresponding bodies at district, state levels and national level also.

Main **objectives** of the scheme

- Comprehensive improvement and restoration water bodies, thereby increasing tank storage capacity.
- Ground Water Recharge.
- Increased availability of drinking water.
- Improvement in agriculture/horticulture productivity.
- Improvement of catchment areas of tank commands.

- Environmental benefits through improved water use efficiency; by promotion of conjunctive use of surface and ground water.
- Community participation and self-supporting system for sustainable management for each water body.
- Capacity Building of communities, in better water management.

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9. Virtual Water

The concept of "**virtual water**" was introduced by Prof. Allan in the early 1990s and refers to the water that is required for the production of agricultural commodities, or in other words the water "embedded" in agricultural products. For instance, it takes 1,600 cubic meters of water on average to produce one metric tonne of wheat. The water is said to be virtual because once the wheat is grown, the real water used to grow it is no longer actually contained in the wheat. The concept of virtual water helps us realize how much water is needed to produce different goods and services. In semi-arid and arid areas, knowing the virtual water value of a good or service can be useful towards determining how best to use the scarce water available.

Virtual water trade refers to the idea that when goods and services are exchanged, so is virtual water. When a country imports one tonne of wheat instead of producing it domestically, it is saving about 1,300 cubic meters of real indigenous water. If this country is water-scarce, the water that is 'saved' can be used towards other ends. If the exporting country is water-scarce, however, it has exported 1,300 cubic meters of virtual water since the real water used to grow the wheat will no longer be available for other purposes. Water-scarce countries like Israel discourage the export of oranges (relatively heavy water guzzlers) precisely to prevent large quantities of water being exported to different parts of the world.

Limitation of the Virtual water measures

- Relies on an assumption that **all sources of water**, whether in the form of rainfall or provided through an irrigation system, **are of equal value**.
- Implicitly assumes that water that would be released by reducing a high water use activity would necessarily be available for use in a less water-intensive activity. For example, the implicit assumption is that water used in rangeland beef production would be available to be used to produce an alternative, less water-intensive activity. As a practical matter this may not be the case, nor might the alternatives be economic.
- Fails as an indicator of environmental harm nor does it provides any indication of whether water resources are being used within sustainable extraction limits. The use of virtual water estimates therefore offer no guidance for policy makers seeking to ensure that environmental objectives are being met.
- Importing food could pose the risk of further political dependence. The notion of "Self Sufficiency" is pride among people of many nations.

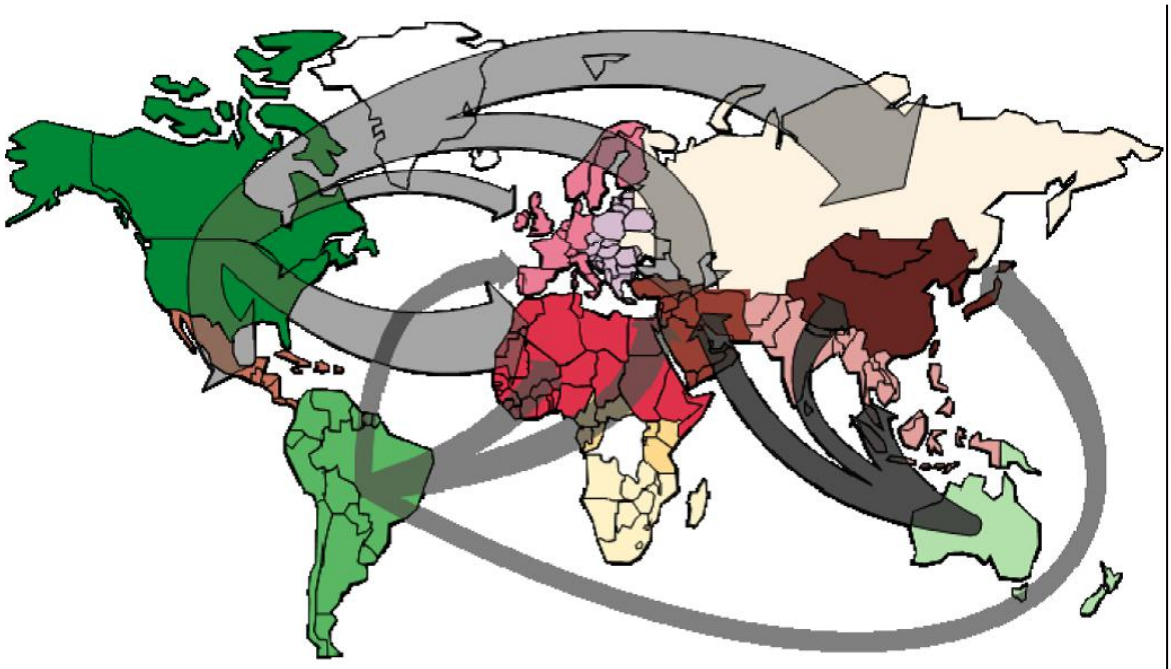


Figure 8: Virtual water flows by the region

In sum, virtual water trade allows a new, amplified perspective on water problems: In the framework of recent developments from a supply-oriented to a demand-oriented management of water resources it opens up new fields of governance and facilitates a differentiation and balancing of different perspectives, basic conditions and interests. Analytically the concept enables one to distinguish between global, regional and local levels and their linkages. This means, that water resource problems have to be solved in ***problemsheds*** if they cannot be successfully addressed in the local or regional watershed. Virtual water trade can thus overcome the hydro-centricity of a narrow watershed view.

References:

Culturable command area (CCA): *The gross command area contains unfertile barren land, alkaline soil, local ponds, villages and other areas as habitation. These areas are called unculturable areas. The remaining area on which crops can be grown satisfactorily is known as cultivable command area (CCA). Culturable command area can further be divided into 2 categories*

- *Culturable cultivated area: It is the area in which crop is grown at a particular time or crop season.*
- *Culturable uncultivated area: It is the area in which crop is not sown in a particular season.*

10. UPSC Prelim Previous Year Question

1. With reference to micro-irrigation, which of the following statements is/are correct?
1. Fertilizer/nutrient loss can be reduced.
2. It is the only means of irrigation in dry land farming.
3. In some areas of farming, receding of ground water table can be checked.

Select the correct answer using the codes given below: (2011)

(a) 1 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

2. If National Water Mission is properly and completely implement, how will it impact the country?
1. Part of the water needs of urban areas will be met through recycling of waste-water.

Student Notes:

2. The water requirements of coastal cities with inadequate alternative sources of water will be met by adopting appropriate technologies that allow for the use of ocean water.
3. All the rivers of Himalayan origin will be linked to the rivers of peninsular India.
4. The expenses incurred by farmers for digging bore-wells and for installing motors and pump-sets to draw ground-water will be completely reimbursed by the Government.

Select the correct answer using the codes given below: (2012)

(a) 1 only (b) 1 and 2 only
(c) 3 and 4 only (d) 1, 2, 3 and 4

3. What are the benefits of implementing the "Integrated Watershed Development Programme"?

1. Prevention of soil runoff
2. Linking the country's perennial rivers with seasonal rivers
3. Rainwater harvesting and recharge of groundwater table
4. Regeneration of natural vegetation

Select the correct answer using the code given below: (2014)

(a) 1 and 2 only (b) 2, 3 and 4 only
(c) 1, 3 and 4 only (d) 1, 2, 3 and 4

4. Consider the following pairs:

Programme		**Project Ministry**
1. Drought-Prone Area Programme	:	Ministry of Agriculture
2. Desert Development Programme	:	Ministry of Environment and Forests
3. National Watershed Development Project for Rainfed Areas	:	Ministry of Rural Development

Which of the above pairs is/are correctly matched? (2014)

(a) 1 and 2 only (b) 3 only
(c) 1, 2 and 3 (d) None

5. Consider the following statements:

1. The Accelerated Irrigation Benefits Programme was launched during 1996-97 to provide loan assistance to poor farmers.
2. The Command Area Development Programme was launched in 1974-75 for the development of water-use efficiency.

Which of the statements given above is/are correct? (2015)

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

6. Which of the following is/are the advantage/advantages of practicing drip irritation?

1. Reduction in weed
2. Reduction in soil salinity
3. Reduction' in-soil erosion

Select the correct answer using the code given below. (2016)

(a) 1 and 2 only (b) 3 only
(c) 1 and 3 only (d) None of the above is an advantage of practising drip irrigation

7. Consider the following statements:

1. 36% of India's districts are classified as "overexploited" or "critical" by the Central Ground Water Authority (CGWA).
2. CGWA was formed under the Environment (Protection) Act.

Student Notes:

3. India has the largest area under groundwater irrigation in the world.

Which of the statements given above is/are correct? (2020)

(a) 1 only (b) 2 and 3 only
(c) 2 only (d) 1 and 3 only

11. UPSC mains Previous Year Question

1. What is water-use efficiency? Describe the role of micro-irrigation in increasing the water-use efficiency. (2014)
2. In what way micro-watershed Development projects help in water conservation in drought prone and semi-arid regions of India. (2016)
3. What is water stress? How and why does it differ regionally in India? (2019)

12. Vision IAS Mains Questions

1. Unscientific use of irrigation water is giving rise to a variety of ecological problems in India. Elucidate.

Approach:

- Introduce the answer by giving a brief highlight of present scenario of irrigation in India.
- Explain in brief the issue of unscientific use of irrigation water.
- Enlist the ecological hazards resulting from the same.
- Conclude by giving a way forward.

Answer:

Irrigation consumes about **84 percent** of total available water in India, while industrial and domestic sectors consume about 12 and 4 percent respectively. India has already realized over **80% of its irrigation potential**. While this reflects significant irrigation expansion, unscientific utilization of irrigation water has raised several issues.

There are multiple factors contributing to unscientific use of irrigation water like **low irrigation efficiency; poor water management; ineffective ground water policy; heavy subsidisation in electricity etc.** Injudicious use coupled with high disparity in the sources of irrigation water (Groundwater 62%, Canals 24%) and irrigation efficiency amplify ecological, agrarian, economic and humanitarian consequences.

Ecological problems resulting from unscientific irrigation:

- **Salinisation, Alkalisation and Waterlogging**: Faulty irrigation practices and absence of proper and adequate drainage facilities are not only responsible for wastage but also increased salinity and alkalinity. This causes land degradation and creates conditions adversely affecting root health of plants.
- **Disappearance of important ecosystems:** Large irrigation projects which impound or divert river water cause major environmental disturbances. Reduced river flow may cause disappearance of ecologically and economically important wetlands or flood forests.
- **Coastal erosion and Salt water intrusion:** Interception for irrigation and consequent reduction of river flow results in reduced discharge of water into the sea. This may cause coastal erosion and salt water intrusion in the river and into the groundwater of adjoining land resources.
- **Reduced downstream water quality:** Upstream land use affects the quality of water entering the irrigation area and also reduces the water supply for downstream ecosystems.
- **Impact on biodiversity:** Dissolution of nutrients in drainage water as it moves through soil profile leads to a buildup of those nutrients in the ground-water aquifer.

Student Notes:

High nitrate levels in drinking water can be harmful to humans and other species. Besides, increased nutrient levels may result in algal blooms, and affects aquatic life.

- **Changes in land use:** It may change land use patterns, increase livestock pressure on remaining lands, induce overgrazing and subsequent soil erosion.
- **Vulnerability to climate change**: Depleting water tables and over extraction worsen uncertainties owing to climate change.
- **Instability in rainfall patterns:** Excessive evaporation owing to unscientific irrigation may result in atmospheric changes impacting rainfall.

Sound water management must be promoted through policy changes, technology based modern practices such as drip irrigation, precision farming etc. Research, scientific evaluations and consultation with all stakeholders must be done before policy formulation. The role of communities in water management must be encouraged. Schemes & practices such as **PM Krishi Sinchai Yojana, vertical farming, dryland farming** can address the problems of overall irrigation efficiency. Such initiatives shall help in achieving **sustainable irrigation objectives under sustainable development goal**.

2. Highlighting the need for Participatory Irrigation Management (PIM) in India, discuss the constraints in implementing PIM.

Approach:

- Introduce by explaining the Participatory Irrigation Management (PIM).
- Highlight the need for its adoption.
- Discuss major challenges in operationalizing PIM in India.
- Give a brief conclusion.

Answer:

Participatory irrigation management (PIM) refers to the co-operation and involvement of farmers in **operation, management, and maintenance** of the irrigation systems by organizing themselves in formal bodies at various levels. For instance, Water Users' Association (WUA), that will have a delineated command area, a Distributary Committee that will comprise of 5 or more WUAs and a Project Committee that will have an apex committee of an irrigation system and presidents of the Distributary committees in the project area.

Need for Participatory Irrigation Management (PIM) in India

- **Need for Increase in Agricultural Productivity:** Proper irrigation management is critical for much needed increase in productivity, food production, alongside growth and competitiveness on the agricultural market**.**
- **Operations & Management (O&M) cost and recovery of irrigation charges:** High O&M cost & cost of recovery of water charges vis-à-vis recovered charges causes severe budget constraints to Government that leads to poor management of irrigation infrastructure.
- **Problem of fiscal availability:** Collective responsibility emphasised by PIM is necessary to reduce the pressure on government finances, by saving up on high costs related to operation and maintenance of irrigation systems.
- **Other compulsions:** There are other compulsions like timely availability of water, immediate problems like leakages, adopting flexibility in water distribution etc. for which, PIM appears extremely necessary.

Constraints in implementing PIM

- **Lack of legal backup and policy changes:** In many States, there is no or very little legal back up and clear-cut policy decisions at the Government level to take up PIM.

Student Notes:

- **System deficiency:** Deterioration of old control and measuring structures, leakages and seepage at various places, erosion of banks and beds, siltation and weed infestation etc. hinders the takeover of the system management by farmers.
- **Uncertainty of water availability:** Farmers are reluctant to take on the responsibility for managing the system unless deliveries of water are made reliable, flexible, practical and responsive to need.
- **Fear of financial viability:** Farmers are apprehensive about timely availability of funds necessary to fulfill the requirement for operation and maintenance.
- **Lack of technical knowledge:** Lack of technical input is one of the inhibiting factors to take over the system.
- **Lack of leadership:** There is a lack of potent local leadership which often leads to negative or unclear guidelines creating further misunderstanding among farmers.
- **Mega irrigation projects:** In comparison to other nations, irrigation projects under PIM in India are huge, which enhances complexity in their maintenance, operation and management aspects.

Thus, there is a need to work upon some fundamental factors, such as common interest and collective efforts of water users, effective leadership of office bearers, capacity building of farmers and irrigation officials, political will of the party in power, proper monitoring and evaluation, catalyzing the role of the change agents etc.

3. The cropping pattern in India is highly skewed towards crops that are water-intensive. In this context, discuss the need to shift the focus from land productivity to irrigation water productivity.

Approach:

- Briefly mention the issues related to cropping pattern in India.
- Highlight the reasons for the highly skewed crop pattern towards water intensive crops.
- Discuss the need to shift the focus from land productivity to irrigation water productivity.
- Conclude accordingly.

Answer:

India's cropping pattern highlights the rampant cultivation of water intensive crops such as sugarcane production in Maharashtra, paddy in North-West India, which are amongst the water stressed regions of India.

Various reasons behind this trend:

- **Government's incentive structure:** The government's policies for various inputs including subsidies on water, power and fertilizer has promoted farmers to cultivate crops, which are highly water intensive such as paddy and sugarcane. Rice and sugarcane crops together consume more than 60% of water available for irrigation.
- **Minimum Support Prices (MSPs):** Though MSPs are currently announced for 23 crops, the most effective price support is for sugarcane, wheat and rice.
- **Demand for water intensive crops:** Rice is one of the most important staple food crop in India. Similarly, there is large industrial demand for crops like cotton, which push the farmers to grow them as they bring larger profits.
- **Increased water demand by crops:** The new artificially modified HYV seeds have been giving higher crop yields, but they require more water than natural seeds.
- **Lack of sensitization**: There is a lack of awareness among farmers about the strain on natural resources due to water-intensive crops. Mostly, the same cropping pattern keeps continuing over the next generation of farmers.

Student Notes:

In this context, **Economic Survey 2018-19** suggests a transition from land productivity to irrigation water productivity, which emphasizes on more crops per drop, improving total nutrition per drop and total food crops per drop. The **need for such a shift is due to the following factors:**

- **Water crisis:** Growing water intensive crops has led to severe water scarcity across various regions like Vidarbha. As per the Niti Aayog, around 600 million Indians are facing high-to-extreme water stress and the situation is set to worsen as water requirements increase.
- **Skewed balance of input and output:** India's agricultural sector accounts for 89 percent of groundwater extraction for irrigation purposes, but contributes only 15 percent to the country's GDP.
- **Nutrition and food security:** To increase irrigation water productivity, there is need to focus on cultivation of less water intensive crops like millets, bajra etc. India could reduce the amount of water it uses for irrigation by a third and simultaneously address its persistent malnutrition problem, if it replaces its rice crop with more nutritious and less thirsty cereals
- **Climate change:** Climate change has increased the frequency of drought in the country. In the coming times, India is going to face water scarcity hence there is a need to focus on improving water productivity.
- **Soil productivity:** After decades of success of the Green Revolution, states like Punjab and Haryana are facing the challenge of soil salinity which has lowered the productivity of soil in the states. Degrading soil productivity is also affecting the sustainability of farming.

In order to bring this shift, governments need to focus on crop diversification, sustainable practices like Zero Budget Natural Farming (ZBNF), nudging farmers to use micro-irrigation techniques such as drip irrigation and micro-sprinklers. The focus should be on growing crops, which are climatically suitable for any region. In Eastern India, water intensive crops can be grown while in semi- arid regions of India like Central India, Rajasthan etc the focus should be on cultivation of less water intensive crops like millets and bajra etc.

4. With water increasingly becoming a scarce resource, large scale adoption of micro irrigation techniques could prove to be a game changer in India. Analyse. Also enumerate various steps taken by the government to promote micro irrigation in India.

Approach:

- Give a brief account of water resource availability and usage in India.
- Discuss how adopting micro irrigation techniques could prove to be a game changer.
- Enumerate various steps taken by the government to promote micro irrigation.

Answer:

India accounts for about 17% of the world population but only 4% of the world's fresh water resources. Demand for water in India is expected to rise drastically to about 833 billion cubic meters (BCM) in 2025 and 899 BCM in 2050. At present, water demand stands at 712 BCM.

Water is a critical determinant of agricultural yields. Almost 75% of India's agriculture is ground water dependent due to poor irrigation systems, and uncertain monsoon, especially from and after Green revolution. However, it is used very inefficiently on the ground.

Student Notes:

In this context, it is argued that large scale adoption of micro irrigation could prove to be a game changer for Indian agriculture in the following ways:

- Micro irrigation techniques like drip and sprinkler enhance the water use efficiency by targeted approach of irrigation, thus removing crop constraints and providing enough water for large scale irrigation.
- It will facilitate cultivation in dryland areas, thus correcting agricultural production disparity between various regions of the country.
- It will help in reclamation of soil by addressing problems like increased soil salinity due to over irrigation.
- With the use of sprinkler irrigation, harmful ditch weeds, which have allelopethic effects, do not appear in the field.
- Provides greater control over water application i.e., runoff losses are reduced significantly because water is applied below or equal to infiltration rate.
- The overall benefits accrued from the micro irrigation system are reflected in the income enhancement of the farmers.

Micro irrigation has generated benefits for farmers in terms of enhancement of productivity. For instance, the average productivity of fruits and vegetables has increased about 42.3% and 52.8%, respectively mainly because of crop spacing, judicious use of water and other inputs etc.

However, adoption of micro irrigation on a large scale in India has certain constraints which need to be addressed like high capital and maintenance cost, declining size of landholdings, unscheduled power outages in rural areas and precipitation of salts.

In order to promote micro-irrigation the Government has taken various steps in India. They are as follows:

- Early adoption of National Mission on Micro Irrigation program, which is now being implemented as 'Per Drop more Crop' component under Pradhan Mantri Krishi Sinchayi Yojana. Under it, financial assistance is available for farmers for adoption of micro irrigation system.
- A dedicated micro irrigation fund with NABARD under PMKSY has been set up.
- Partnership with countries such as Israel with the objective of sharing best practices and technical knowledge.

Further, various steps taken have been taken by Government for promotion of micro irrigation include such as training and awareness programmes, organization of workshops, seminars and interactive meetings, publicity creation through exhibitions, fairs and Kisan Melas and short duration films.

Overall, micro-irrigation will certainly prove to be a game changer for water starved Indian agriculture, if the hurdles and limitations in achieving successful implementation of micro-irrigation are surpassed.

5. Despite being a water-stressed economy, micro irrigation penetration in India remains sub-optimal. Discuss the reasons behind it. Also list measures taken by the government to provide an impetus to micro irrigation.

Approach:

- Give a brief overview of the extent of micro-irrigation in India.
- State the reasons for low penetration of micro-irrigation.
- Mention the measures taken by the government to give an impetus to micro-irrigation.

Answer:

Student Notes:

- A study by FICCI and Irrigation of India reveals that by 2015, 7.73 million hectares of land were covered under micro-irrigation, compared to a potential of 69.5 million hectares.
- Six states- Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Gujarat and Haryana account for over 82% of India's micro-irrigation coverage.
- Thus, penetration of micro-irrigation is highly skewed and far below potential especially in a country like India which is a water-stressed economy.

Reasons for low penetration of micro-irrigation include:

- Initial high costs required for setting up the infrastructure.
- Farmers have limited knowledge of its usage and lack technological knowhow. They also are unaware of the benefits of micro-irrigation.
- There is poor implementation of government subsidy policies provided to incentivise micro-irrigation.
- Regular monitoring is required to de-clog the equipment, which is sensitive to damages from rodents, insects, etc.
- Micro-irrigation requires pressure for water delivery in delivery lines regardless of whether the source of water is surface or groundwater. However, India's energy crisis affects the timing and supply of water to crops.

Measures taken by the government to give impetus to micro-irrigation are:

- Creation of a dedicated micro irrigation fund with a corpus of Rs. 5,000 crore has been setup under NABARD.
- Pradhan Mantri Krishi Sinchai Yojana(PMKSY), 2015 with the motto of 'Har Khet Ko Paani' for providing end-to end solutions in irrigation supply chain, viz. water sources, distribution network and farm level applications.
- PMKSY also focuses on creating protective irrigation by harnessing rainwater at micro level to ensure 'Per drop-more crop' through 'Jal Sanchay' and 'Jal Sinchan' projects.
- Other measures include training programmes, awareness through print media, short films, radio and TV talks, organization of workshops, seminars and interactive meetings, publicity creation through exhibitions, fairs and kisan melas, etc.

6. While access to irrigation is important, efficiency of water use is equally, if not more, crucial. Examine.

Approach:

- Briefly examine the importance of ensuring access to irrigation.
- Broadly establish the need to ensure water use efficiency in agriculture.

Answer:

Irrigation plays a protective role against vagaries of rainfall and drought. With the adoption of high yielding varieties, chemical fertilizers and multiple cropping, highly controlled irrigation is quintessential for productive agriculture. It also paves the way for optimal utilization of cultivable wasteland for cultivation. However, in a water stressed country where agriculture accounts for about 70 percent of total usage of water, it is imperative that use of water be made efficient by increasing its absorption and reducing its wastage.

Water use efficiency indicates the ratio between effective water use and actual water withdrawal. It is to used describe how effectively water is delivered to crops and to indicate the amount of water wasted at plot, farm, command, or system level.

Student Notes:

Currently, around 52% farm field i.e. 73.2 million hectares out of 141.4 million hectares net sown area is still un-irrigated in India. As such, ensuring access to irrigation is pertinent to lessen the regional & size-class inequalities in agricultural productivity which directly impacts socio-economic imbalances.

With availability of irrigation, rice yields in Punjab and Haryana have been highest in the country (comparable to China). Also, they have increased substantially in hitherto low yield areas of Chhattisgarh and Jharkhand. However, the amount of water used in Punjab is about 3 times more than used in Jharkhand. This shows that with improving water use efficiency, higher yields can also be obtained.

Importance of Water Use Efficiency:

- Diversification of economy away from agriculture, rising population and increasing urbanization, has intensified inter-sectoral competition for water in developing countries like India.
- Agriculture sector accounts for 78 per cent of freshwater use in water-stressed country like India and total evapotranspiration could double in next 50 years if trends in food consumption and current practices of production continue.
- Vulnerability of agriculture to natural disasters like drought is likely to increase with climate change, making it furthermore important to efficiently utilize the scarce water resources.
- Due to poor agro-climatic planning, cropping patterns show a mismatch with the irrigation water potential of that area (particularly for water guzzler crops like rice and sugarcane). For example relatively water abundant eastern states of India, lag behind in the production of rice and sugarcane. Water presents itself as a more binding constraint to Indian agriculture than land.

Investing more in augmenting irrigation infrastructure may not serve the purpose fully unless it is accompanied by policies and programmes that promote higher water-use efficiency in agriculture. Recently NABARD Report pointed out the need to shift from crop productivity to water productivity implying that there is a need to realign the focus from maximizing productivity per unit of land area to per unit of water, thus achieving 'more crop per drop'.

This may be achieved by promoting drip and sprinkler irrigation systems, robust agro-climatic planning, watershed development and water harvesting & management projects. The future lies in making agriculture water-smart, water-secure and environmentally sustainable.

Student Notes:

DISTRIBUTION OF KEY NATURAL RESOURCES ACROSS THE WORLD (INCLUDING SOUTH ASIA AND THE INDIAN SUB-CONTINENT

Contents

Student Notes:

1. Introduction

Natural resources which satisfy the material and spiritual needs of humans are the free gifts of the nature. In other words, any material or energy derived from the nature that is used by humans called a **natural resource**. These resources include land, water, minerals, vegetation, wildlife etc. In fact every material has some utility for human beings but its utilisation is possible on the availability of appropriate technology.

Distribution of natural resource refers to the geographic occurrence or spatial arrangement of resources on earth. In other words, where resources are located. Any one place may be rich in the resources people desire and poor in others.

1.1. Uneven Distribution of Resources

Low latitudes (latitudes close to the equator) receive more of the sun's energy and much precipitation, while higher latitudes (latitudes closer to the poles) receive less of the sun's energy and too little precipitation. The temperate deciduous forest biome provides a more moderate climate, along with fertile soil, timber, and abundant wildlife. The plains offers flat landscapes and fertile soil for growing crops, while steep mountains and dry deserts are more challenging. Metallic minerals are most abundant in areas with strong tectonic activity, while fossil fuels are found in rocks formed by deposition (sedimentary rocks).

However, uneven distribution of natural resources have their own consequences on human settlement, economic activities, trade and even on conflict and war. Human settlement has been found near the natural resources in pre-historic time. Natural resources form the backbone of the economy of a nation. Without land, water, forest, mineral one cannot develop agriculture and industry. By utilising natural resources, humans created their own world of houses, buildings, means of transport and communication, industries etc.

2. Classification of Resources

Resources can be classified in several ways: one the bases of (i) renewability, (ii) origin and (iii) utility. The objective of classification would primarily decide how we put a resource under a particular category.

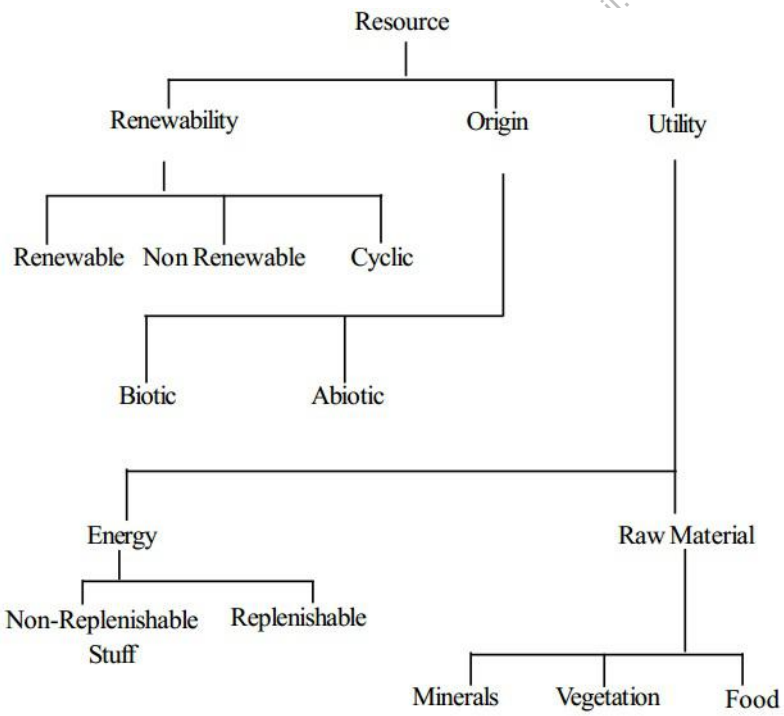


Figure 1: Classification of Resources

Student Notes:

3. Energy Resources

Energy is an essential input for economic development and improving the quality of life. It is required for generation of power, required by agriculture, industry, transport and other sectors of the economy. Energy may be classified into two categories, namely:

- **Conventional** – Coal, Petroleum, Natural gas and electricity
- **Non-conventional** – solar, wind, tidal, geothermal, and biogas energy

Other classification can be made between –

- **Non-renewable** resources – which when exhausted are exhausted forever such as coal etc.
- **Renewable** resources – which are inexhaustible such as wind energy, solar energy etc.

3.1. Coal

Coal is a one of the important minerals which is mainly used in the generation of thermal power and smelting of iron ore. It is the one of the most mined mineral from the earth. According to one estimate, proven coal reserves are 860, 938 million tonnes.

Of the three fossil fuels (Petroleum, natural gas and coal), coal has the most widely distributed reserves; coal is mined in over 100 countries, and on all continents except Antarctica. The largest proved reserves are found in the United States, Russia, China, Australia and India (figure 2). A proved recoverable reserve is the tonnage of coal that has been proved by drilling etc. and is economically and technically extractable. Coal is found majorly in forms of Lignite [1] and Anthracite. Distribution of coal across the world is shown in figure 3.

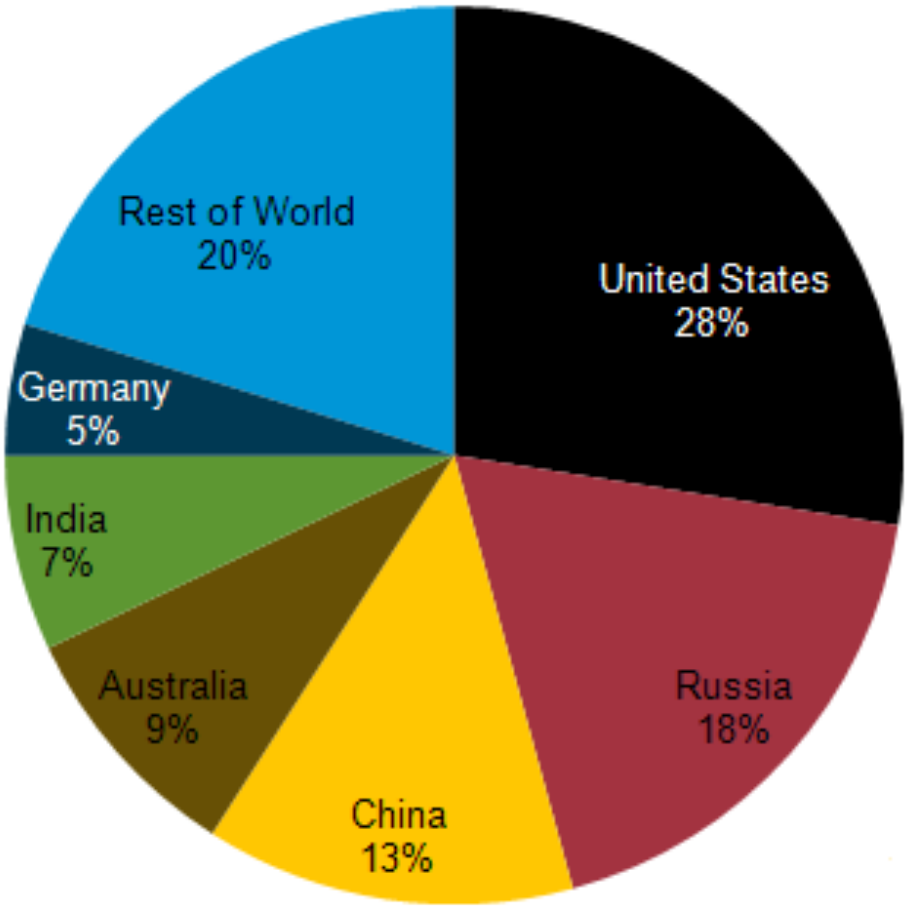
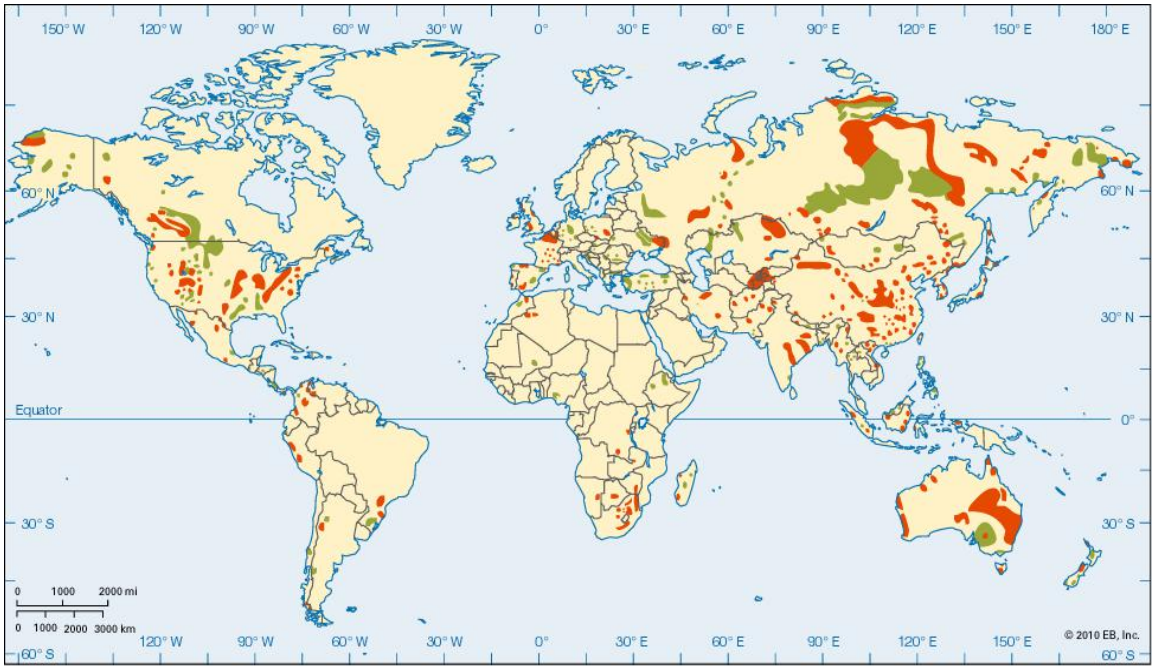


Figure 2: Global share of recoverable coal reserves

Student Notes:



Major Coal Deposits of the World

Anthracite and Bituminous Coal Lignite

Figure 3: coal deposits of the world

In terms of **production**, China is the top coal producer since 1983. In 2011 China produced 3,520 millions of tonnes (mt) of coal – 49.5% of 7,695 million tonnes world coal production. In 2011 other large producers were United States (993 mt), India (589 mt), European Union (576 mt) and Australia (416 mt). **Top coal exporting countries** are Australia with 27% and Indonesia with 26% of total world coal export in 2010. Japan is the largest **coal importer** with 17% of total world coal import seconded by China having share of 16% in 2010. Major coalfields of the world are listed in the table 1.

North America	• Pennsylvania anthracite field • Appalachian bituminous field • Eastern Illinois field – Illinois, Indiana and Kentucky • Western interior field – Iowa, Missouri, Oklahoma • Gulf province – Texas, Alabama and Arkansas • Rocky mountain province- Utah, Colorado, Wyoming, Montana, new Mexico • Canada – Prairies, British Columbia coalfields, Nova Scotia Coal fields
Europe	• Donetz coal basin (anthracite and high grade bituminous coal) • Moscow-Tula coalfields • Kuznetsk coal basin • Karaganda field • Silesia coal fields • Ruhr area of Germany • Other coal fields in Urals, Taimyr fields of the Arctic, deposits of the Caucasus mountains
Asia	• China – Shanxi, Fushun, Inner Mongolia, Kansu • Japan – Chikugo coalfield, Ishikari coalfield • India – Damodar valley, Raniganj, Bokaro, Jharia, Singareni. • Pakistan - Quetta, Kalabagh and Thar coalfields • Australia – Bowen Basin coalfield, Galilee Basin coalfield, South Maitland coalfield, Sydney Basin coalfield, and Latrobe valley coalfield

Africa	• Transvaal and Natal – Middleburg, Vereeniging and Witbank • Zimbabwe – Wankie • Zaire – Luena • Mozambique – Maniamba • Zambia – Nkandabwe and Mamba • Nigeria – Enugu
South America	• Brazil – Santa Catarine and Rio grande de sul • Chile – Concepcion • Columbia – Cauca valley coalfield • Mexico – Piedras Negras, Sabinas and Lampazos

Table 1 – Distribution of coal across continents

3.1.1. Coal in India

Coal is the most important and abundant fossil fuel in India. It accounts for 55% of the country's energy need. Hard coal deposit spread over 27 major coalfields, are mainly confined to eastern and south central parts of the country. A **cumulative total of 2,93,497 million tonnes** of geological resources of Coal upto depth of 1200 meters have so far been estimated in the country as on 1.4.2012.

The lignite reserves stand at a level of 41.96 billion tones as on 1.4.2012, of which 90% occur in the southern State of Tamil Nadu. Other states where lignite deposits have been located are Rajasthan, Gujarat, Kerala, Jammu & Kashmir, and union territory of Puducherry

The coal resources of India are available in **older Gondwana** (570 million years to 245 million years ago) formations of peninsular India and **younger tertiary** (60 to 15 million years ago) formations of north-eastern region. Formation-wise coal resources of India as on 1.4.2012 are given in table 2 below:

Formation	Proved (million tonnes)	Total (million tonnes)
Gondwana coals	117551.01	292004.51
Tertiary coals	593.81	1492.64
Total	118114.82	293497

Table 2: Estimations for different types of coal based on formation

The **Gondwana** coal belongs to the carboniferous period. It is found in the Damodar, Mahanadi, Godavari, and Narmada valleys. Raniganj, Jharia, Bokaro, Ramgarh, Giridih, Chandrapur, Karanpura, Tatapani, Talcher, Himgiri, Korba, Penchgati, Sarguja, Kamthi, Wardha valley, Singreni (A.P.) and Singrauli are some of the important coal mines of the Gondwana formations. **The Jharguda coal mine (Chhattisgarh) is the thickest coal seam** 132 meters of the Gondwana period, followed by the Kargali seam near Bokaro belong to the Gondwana period. The detail of state-wise geological resources of Gondwana coal is given below in table 3.

State	Proved (million tonnes)	Total (million tonnes)
Andhra Pradesh	9566.61	22154.86
Chhattisgarh	13987.85	50846.15
Jharkhand	40163.22	80356.2
Madhya Pradesh	9308.70	24376.26
Maharashtra	5667.48	10882.09
Odisha	25547.66	71447.41
Uttar Pradesh	884.04	1061.80
West Bengal	12425.44	30615.72
Total	117551.01	292004.51

Table 3: Gondwana coalfields

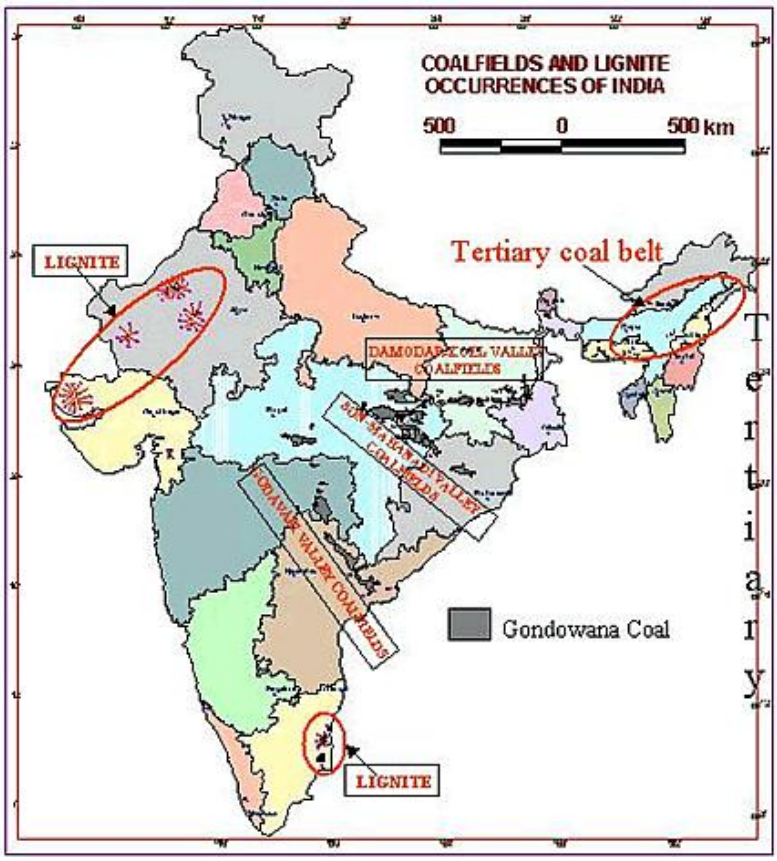


Figure 4: Major coalfields of India

Tertiary coal is found in the rocks of the Tertiary era. It is about 15 to 60 million years old. The Tertiary coal is also known as the 'brown coal'. The Tertiary coal contributes only about two per cent of the total coal production of the country. It is an inferior type of coal in which the carbon varies between 30 per cent in Gujarat and Rajasthan to 50 per cent in Assam. Lignite coal is found in Arunachal Pradesh and West Bengal (Darjeeling District). The **largest lignite deposits of the country are at Neyveli** in the state of Tamil Nadu. The detail of state-wise geological resources of tertiary coal is given below in table 4.

State	Proved (million tonnes)	Total (million tonnes)
Arunachal Pradesh	31.23	90.23
Assam	464.78	510.52
Meghalaya	89.04	576.48
Nagaland	8.76	315.41
Total	593.81	1492.64

Table 4: Tertiary coalfields

3.2. Petroleum

Petroleum is also called 'black gold' or 'liquid gold'. It is second to coal in terms of sources of energy. It is an essential source of energy for all internal combustion engines in automobiles, railways and aircraft. Crude petroleum occurs in sedimentary rocks of the tertiary period. It is formed when large quantities of dead organisms, usually zooplankton and algae, are buried underneath sedimentary rock and subjected to intense heat and pressure.

Petroleum (and natural gas) are born and accumulate in the sedimentary mantle of the Earth. Small amounts of these hydrocarbons are present throughout the mantle, but large accumulations are encountered less frequently. About 600 sedimentary basins, characterized by oil and gas occurrence, are found on the Earth.

Student Notes:

Unlike coal, Petroleum is not distributed evenly around the world. More than half of the world's proven oil reserves are located in the Middle East (figure 5). Following the Middle East are Canada and the United States, Latin America, Africa, and the region occupied by the former Soviet Union. Each of those regions contains less than 15 percent of the world's proven reserves [2].

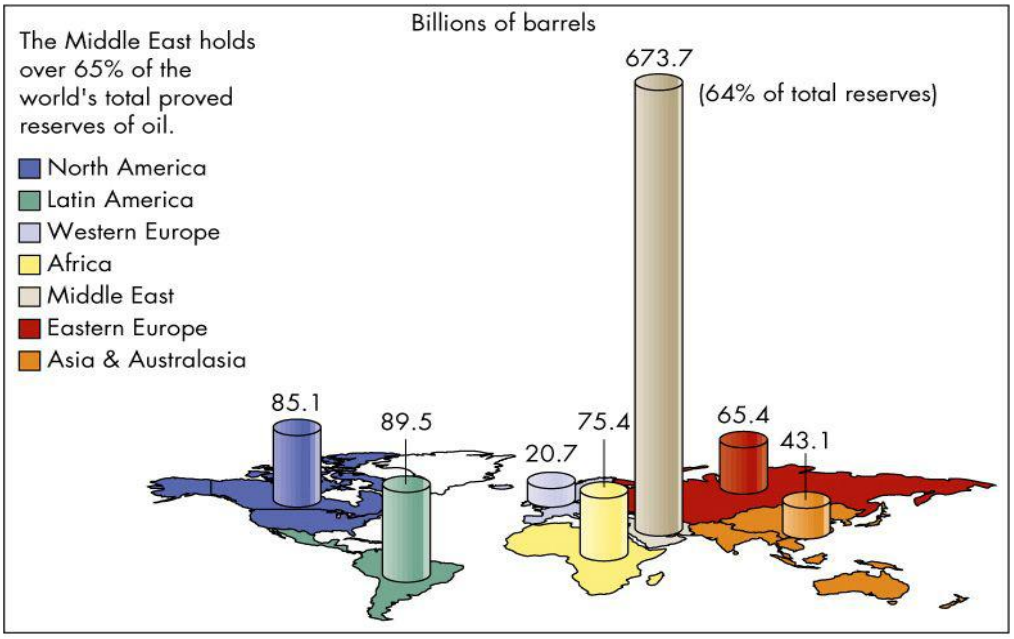


Figure 5: Worldwide Oil Distribution

Since exploration for oil began during the early 1860s, some 50,000 oil fields have been discovered. More than 90 percent of these fields are insignificant in their impact on world oil production. The two largest classes of fields are the **super-giants**, fields with 5 billion or more barrels of ultimately recoverable oil, and **world-class giants**, fields with 500 million to 5 billion barrels of ultimately recoverable oil. Fewer than 40 supergiant oil fields have been found worldwide. The Arabian-Iranian sedimentary basin in the Persian Gulf region contains two-thirds of these supergiant fields. The remaining super-giants are distributed as follows: two in the United States, two in Russia, two in Mexico, one in Libya, one in Algeria, one in Venezuela, and two in China.

The nearly 280 world-class giant fields thus far discovered, plus the super-giants, account for about 80 percent of the world's known recoverable oil. There are, in addition, approximately 1,000 known **large oil fields** that initially contained between 50 million and 500 million barrels. These fields account for some 14 to 16 percent of the world's known oil. **Major oil fields** are listed below:

- Ghawar field – Saudi Arabia
- Burgan field – Kuwait
- Azeri-Chirag-Guneshli – Caspian Sea, Azerbaijan
- Ku-Maloob-Zaap – Mexico
- Zakum - UAE
- Ferdows field – Iran
- Sugar Loaf field – Brazil
- Bolivar Coastal field – Venezuela

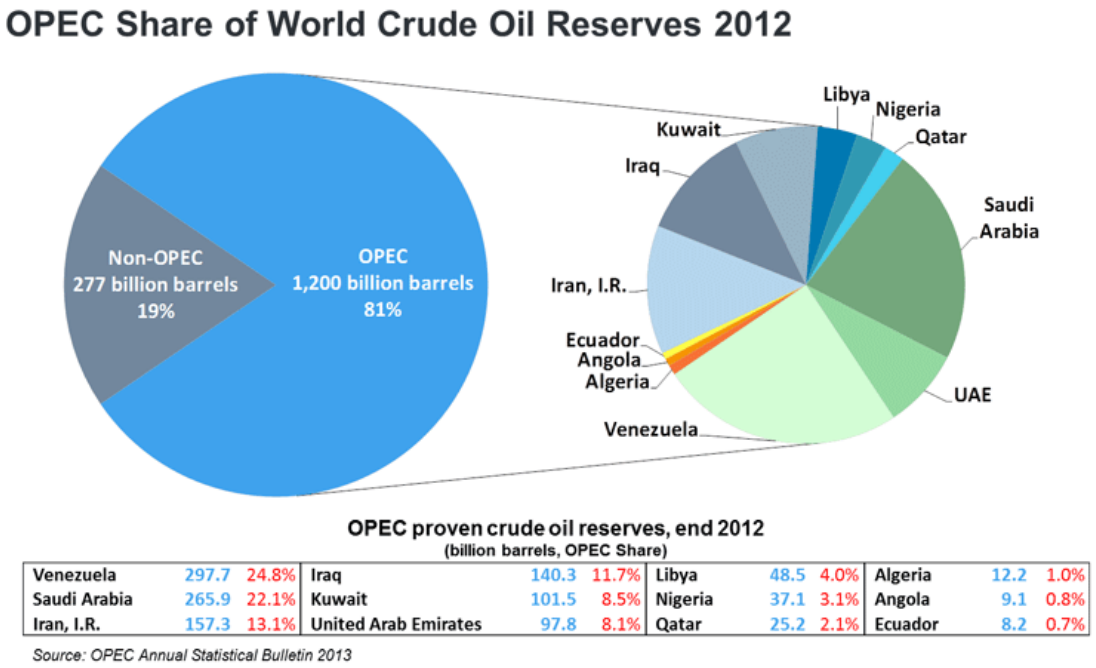
World's five **largest offshore** oilfields:

- Safaniya oilfield – Persian Gulf, Saudi Arabia
- Upper Zakum oilfield – Persian Gulf, UAE

Student Notes:

- Manifa oilfield – Persian Gulf, Saudi Arabia
- Kashgan oilfield – Caspian Sea, Kazakhstan
- Lula Oilfield - Brazil

According to current estimates, more than 81% of the world's proven oil reserves are located in OPEC Member Countries, with the bulk of OPEC oil reserves in the Middle East (figure 6). OPEC Member Countries have made significant additions to their oil reserves in recent years. As a result, OPEC's proven oil reserves currently stand at 1,200.83 billion barrels.



OPEC proven crude oil reserves, end 2012
(billion barrels, OPEC Share)

Venezuela	297.7	24.8%	Iraq	140.3	11.7%	Libya	48.5	4.0%	Algeria	12.2	1.0%
Saudi Arabia	265.9	22.1%	Kuwait	101.5	8.5%	Nigeria	37.1	3.1%	Angola	9.1	0.8%
Iran, I.R.	157.3	13.1%	United Arab Emirates	97.8	8.1%	Qatar	25.2	2.1%	Ecuador	8.2	0.7%

Source: OPEC Annual Statistical Bulletin 2013

Figure 6: Share of Organization of the Petroleum Exporting Countries (OPEC) in world crude oil reserves 2012

Classification of crude oil

Crude oil may be referred to as sweet if it contains relatively little sulfur (0.5%) or *sour* if it contains substantial amounts of sulfur. **Sweet crude** requires less energy to be extracted and once extracted, yields higher quality gasoline as well as larger quantities of it. Iraq is one of the leading producers of sweet crude. Major locations where sweet crude is found include the Appalachian Basin in Eastern North America, Western Texas, the Bakken Formation of North Dakota and Saskatchewan, the North Sea of Europe, North Africa, Australia, and the Far East including Indonesia.

Sour crude, on the other hand, has a high level of impurities in it, namely sulfur, which must first be removed before being processed into gas and other petroleum based products. Venezuela is a leading producer of sour crude oil. Sour crude is more common in the Gulf of Mexico, Mexico, South America, and Canada. Crude produced by OPEC Member Nations also tends to be relatively sour, with an average sulfur content of 1.77%.

According to IEA top 10 oil producer countries produced over 64 % of the world oil production in 2012. In 2012 total oil production was 4,142 Mt. The **top oil producers in 2012** were:

- Russia - 544 Mt (13 %)
- Saudi Arabia - 520 Mt (13 %)
- United States - 387 Mt (9 %)
- China - 206 Mt (5%)
- Iran - 186 Mt (4 %)
- Canada - 182 Mt (4 %)

- United Arab Emirates (UAE) - 163 Mt (4 %)
- Venezuela - 162 Mt (4 %)
- Kuwait - 152 Mt (4 %)
- Iraq - 148 Mt (4 %).

Student Notes:

3.3. Natural Gas

Natural gas is a fossil fuel formed when layers of buried plants, gases, and animals are exposed to intense heat and pressure over thousands of years. The energy that the plants originally obtained from the sun is stored in the form of chemical bonds in natural gas. Natural gas, a nonrenewable energy resource, is found in deep underground rock formations or associated with other hydrocarbon reservoirs in coal beds and as methane clathrates. Petroleum is another resource and fossil fuel found in close proximity to, and with natural gas.

Like Petroleum, natural gas is not distributed evenly around the world. More than three-fourth of the world's proved natural gas reserves are located in top ten countries (figure 7). Following the Russia are Iran and Qatar, Turkmenistan, USA. Small gas fields are located in various parts of the world. [2]. Unconventional sources of natural gas are:

- Shale gas
- Coalbed methane (CBM)
- methane hydrates

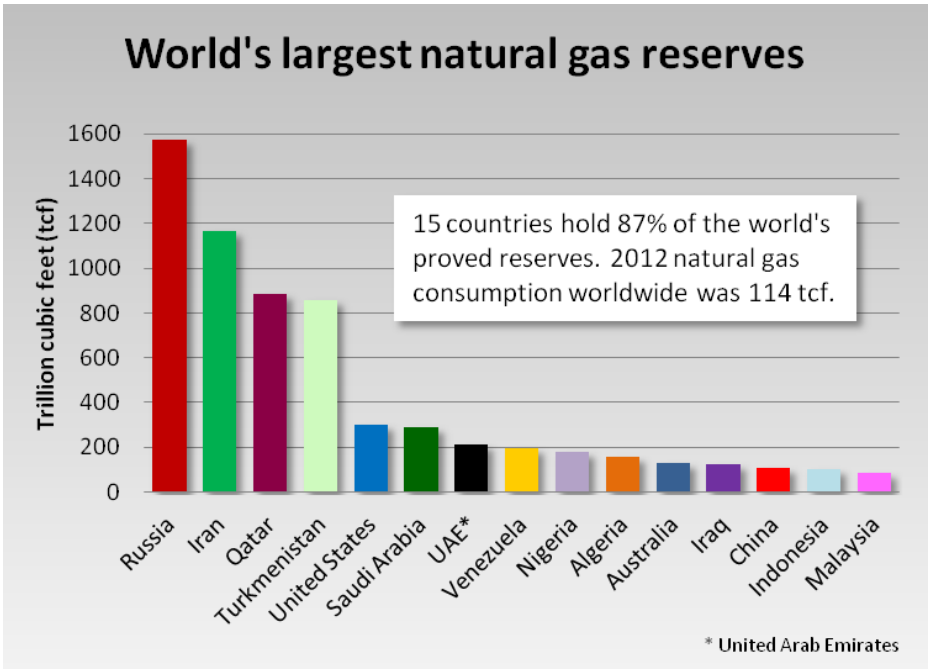


Figure 7: Countries with largest proved natural gas reserves

Some of the largest gas fields are listed below:

- South Pars/North Dome – Persian Gulf, Iran and Qatar
- Urengoy – Siberian Basin, Russia
- Yamburg – Arctic circle, Russia
- Hassi R'Mel – Algeria
- Shtokman – Barents Sea, Russia
- South lolotan-Osman – Turkmenistan
- Zapolyarnoye – Russia
- Hugoton – USA
- Groningen – Netherlands
- Bovanenko – Russia

Student Notes:

As measured by the International Energy Agency, the **top 10 natural gas producers in 2011** were (66.7% of total):

- Russia (20.0%)
- United States (19.2%)
- Canada (4.7%)
- Qatar (4.5%)
- Iran (4.4%)
- Norway (3.1%)
- China (3.0%)
- Saudi Arabia (2.7%)
- Indonesia (2.7%)
- Netherlands (2.4%)

3.3.1. Shalegas

Shale gas is a natural gas produced from shale, a type of sedimentary rock. Due to constant announcements of shale gas recoverable reserves, as well as drilling in Central Asia, South America and Africa, deepwater drilling, estimates are undergoing frequent updates, mostly increasing. Since 2000, some countries, notably the US and Canada, have seen large increases in proved gas reserves due to development of shale gas, but shale gas deposits in most countries are yet to be added to reserve calculations. Some analysts expect that shale gas will greatly expand worldwide energy supply. Figure 8 shows the major shale gas fields of the word. **China is estimated to have the world's largest** shale gas reserves followed by USA, Argentina, Mexico, South Africa, Australia, and Canada (table 5).

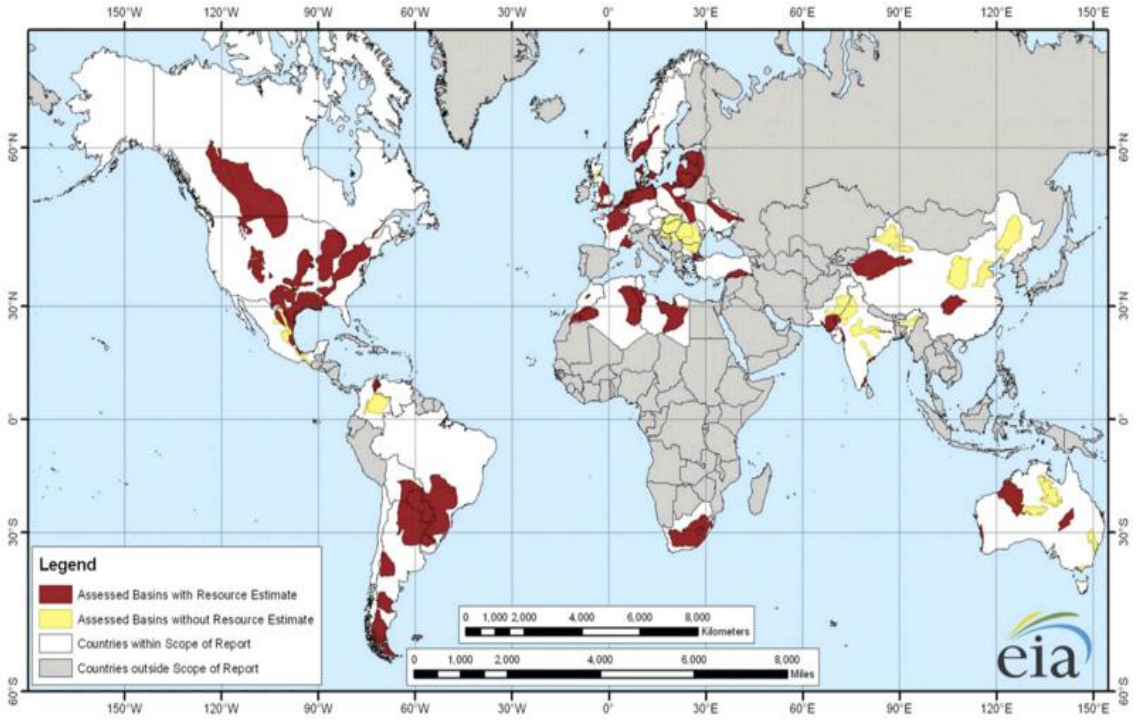


Figure 8: World Shale Gas

The United States and Canada are the major producers of commercially viable natural gas from shale formations in the world, even though about a dozen other countries have conducted exploratory test wells. China is the only nation outside of North America that has registered commercially viable production of shale gas, although the volumes contribute less than 1% of the total natural gas production in that country. In comparison, shale gas as a share of total natural gas production in 2012 was 39% in the United States and 15% in Canada.

Student Notes:

Country	Estimated recoverable reserves (trillion cubic feet)	Proven gas reserves(trillion cubic feet)
China	1, 275	107
USA	862	272.5
Argentina	774	13.4
Mexico	681	12
South Africa	485	-
Australia	396	110
Canada	388	62
Libya	290	54.7
Algeria	231	159
Brazil	226	12.9

Table 5: List of top 10 countries by recoverable shale gas

3.3.2. Coalbed Methane (CBM)

CBM is generated by the conversion of plant material to coal through burial and heating. As "coalification" progresses, increasingly dense coal is formed. Coal serves as both the source rock and the reservoir rock. Coal is extremely porous but has low permeability (connected openings). Much of the methane generated by the coalification process escapes to the surface or migrates into adjacent reservoir or other rocks, but a significant volume remains trapped within the coal itself.

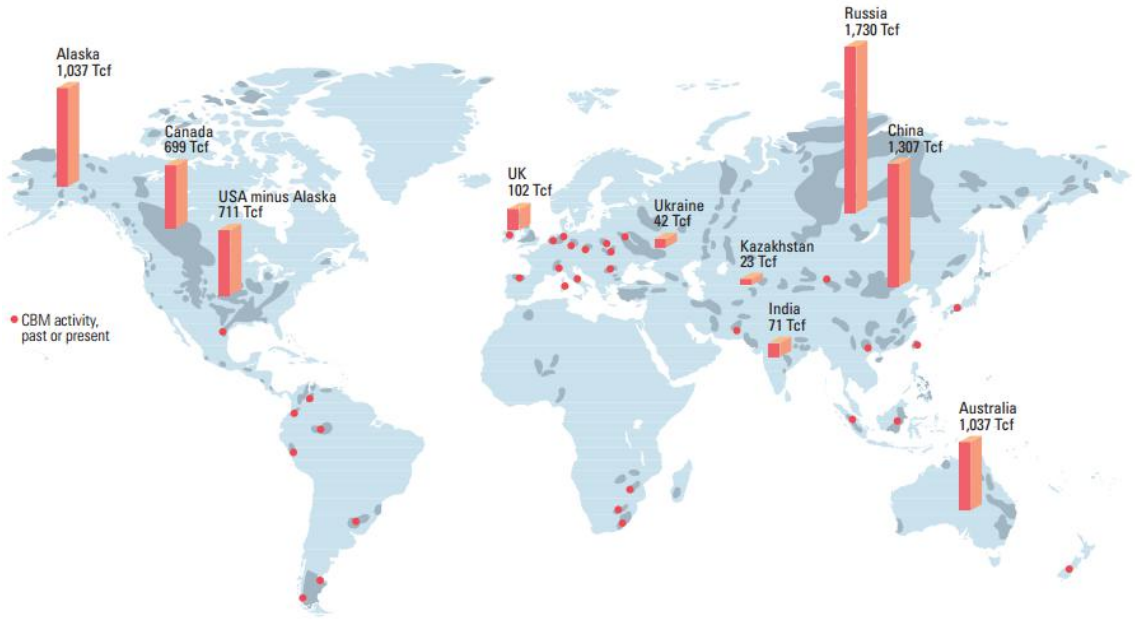


Figure 9: Major coalbed Methane reserves

CBM can be found almost anywhere there is coal. Figure 9 shows CBM resources by top countries. Deep coal seams beyond the reach of mining operations present opportunities for development of CBM. The largest proven recoverable coal reserves, according to the latest published data, are in the USA (28.6%), followed by Russia (18.5%), China (13.5%), Australia (9.0%) and India (6.7%). Indonesia has highly prospective CBM potential, with an estimated 453 Tcf of in-place resources located mainly in Sumatra and Kalimantan provinces. Depending on the source, Russia's resource estimates range from 600 to 2,825 Tcf.

Global CBM production totals 5.8 Bcfd (billion cubif feet per day) from 15 basins in the USA, Canada, Australia, China, and India. The USA still dominates with nearly 5 Bcfd of production and about 20 Tcf produced to date, but production there is expected to fall going forward

because of resource maturity and depletion. Australia may well displace the USA as the top-ranked producer, making a projected 6 Bcfd by 2020 once its LNG export plants are fully operational. CBM production in China (150 MMcfd) and India (10 MMcfd) is struggling due to more challenging geologic conditions and low well productivity.

Student Notes:

3.4. India – Petroleum – Petroleum and Natural Gas

Oil exploration and production was systematically taken up after the Oil and Natural Gas Commission was set up in 1956. Till then, the **Digboi in Assam** was the only oil producing region but the scenario has changed after 1956. **Mumbai High** which lies 160 km off Mumbai was discovered in 1973 and production commenced in 1976. In recent years, new oil deposits have been found at the extreme western and eastern parts of the country.

State/region	Reserves in million metric tonnes
Gujarat	136.73
Assam (includes north eastern reserves)	178.07
Andhra Pradesh	7.42
Tamil Nadu	9.21
Western Offshore (includes Bombay High, Rajasthan)	396.41
Eastern Offshore	30.43
Total	758.27

Table 6: Reserves of Crude Oil in India (2013)

India has total reserves (proved & indicated) of 758 million metric tonnes of crude oil (table 6) and 1355 billion cubic meters of natural gas (table 7) as on 1.4.2013. Onshore and offshore crude oil constitutes 398 million metric tonnes and 360 million metric tonnes respectively. Geographical distribution of **crude oil** indicates that the maximum reserves are in the western offshore including Bombay High and Rajasthan (52%) followed by Assam (23%) whereas maximum reserves of **natural gas** are in the Eastern offshore including CBM in West Bengal (38%) followed by western offshore including Bombay High, Rajasthan, Madhya Pradesh and Jharkhand (36%). The increase in the estimated natural gas reserves is largely from CBM.

State/region	Reserves in billion cubic meters
Gujarat	77.53
Assam (includes north eastern reserves)	181.77
Andhra Pradesh	48.21
Tamil Nadu	45.83
Western Offshore (includes Bombay High, Rajasthan, Madhya Pradesh and Jharkhand)	488.20
Eastern Offshore (Includes CBM in West Bengal)	513.22
Total	1354.76

Table 7: Reserves of Natural Gas in India (2013)

The 15 basins out of a total 26 **sedimentary basins** (figure 10) in India have prognosticated hydrocarbon resources of about 206 Billion barrels of oil equivalent spread across **onland**, **offshore** and **deepwater** areas. Total area under these basins is 3 million sq. km. Over the last twelve years, there have been significant forward steps in exploring the hydrocarbon potential of the sedimentary basins of India. The unexplored area has come down to 15% which was 50% in 1995-96.

Figure 10: sedimentary Basin of India

Oil and natural gas have been found in exploratory wells in Krishna-Godavari and Kaveri basin on the east coast. Largest natural gas discovery has been made **in Krishna-Godavari deep waters**. Similarly, largest oil discovery after Bombay High has been made in the **Barmer oil fields** of Rajasthan. In **Assam**, Digboi, Naharkatiya and Moran are important oil producing areas. The **major oil fields** of **Gujarat** are Ankaleshwar, Kalol, Mehsana, Nawagam, Kosamba and Lunej. Exclusive reserves of natural gas are located along the eastern coast as well as Tripura, Rajasthan and off-shore wells in Gujarat and Maharashtra. Some of the major oil and gas discoveries in 21st century are shown in figure 11.

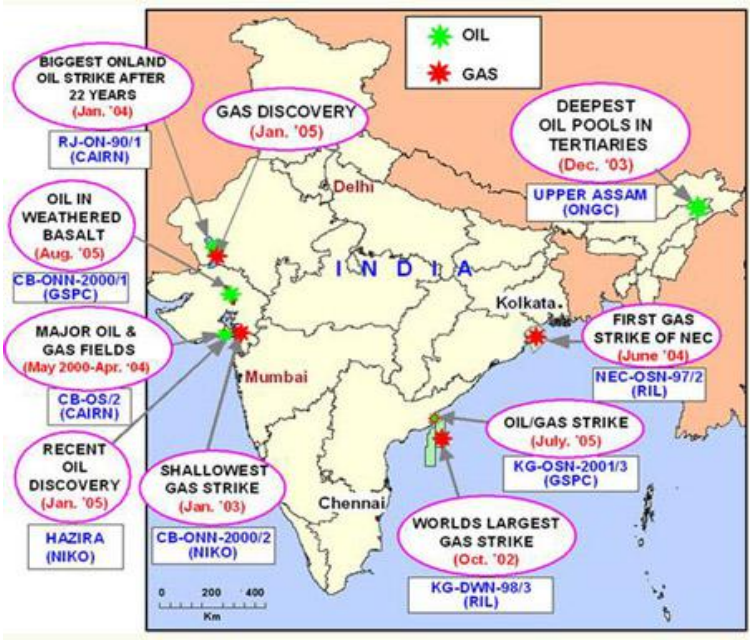


Figure 11: Major Oil and Gas discoveries after 2000

Coalbed Methane (CBM)

India has substantial coal reserves and most are suitable for **CBM** development. Deep coal deposits, not accessible by conventional mining operations, also offer CBM development opportunities. In 1997, India's government formulated a CBM policy and allotted a number of blocks for exploration. Commercial production of CBM began in 2007. The first CBM production started in 2007 from Raniganj in West Bengal. Government aims to offer up to 90% of total coal bearing area by the end of 2016-17 for exploration and production of CBM. The CBM reserves as per Directorate General of Hydrocarbons is tabulated here under:

Student Notes:

State	Coalfields/block	Reserves in billion cubic metres
West Bengal	North Raniganj, Eastern Raniganj and Birbhum	109.87
Jharkhand	Jharia, East and West Bokaro, North Karanpura	174.93
Madhya Pradesh	Sohagpur, Satpura	114.11
Gujarat	Cambay Basin	311-549 (advance estimates)
Total		710 - 948

Table 8: CBM reserves of India

Shale gas

Shale gas has reduced America's dependence on oil imports, leading other countries to look for such reserves. India, too, has potential to reduce its dependence on imports by tapping the potential of shale gas. Six onshore basins — Cambay, Krishna-Godavari, Cauvery, Assam-Arakan, Ganga and Gondwana/Damodar—have been identified for shale exploration (figure 12). The Indian Government entered into a MoU with the United States Geological Survey (USGS) to conduct an assessment of the shale gas resources.

According to the US Energy Information Administration, India could be sitting on as much as 96 TCF of recoverable shale gas reserves, equivalent to about 26 years of its gas demand, compared with its 43.8 TCF of natural gas reserves at the end of 2012. Another estimate, by Schlumberger Company, has indicated a shale gas resource base of between 600 Tcf and 2,000 Tcf.

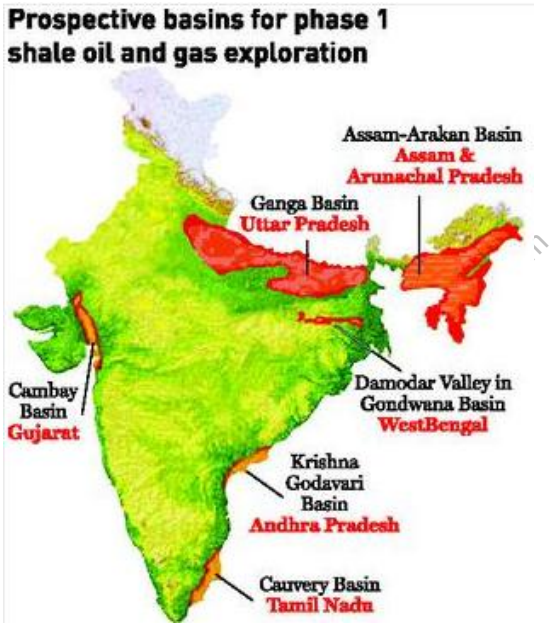


Figure 12: Shale oil and gas basins of India

Krishna Godavari basin, located in eastern India, is considered to hold the largest shale gas reserves in the country. The basin is estimated to have around 27 Tcf of technically recoverable gas. The **Cauvery** basin in Tamil Nadu state is estimated to have recoverable shale gas reserves of 7 Tcf. The **Cambay** basin in Gujarat is the largest basin in the country, spread across 51,800 sq km. As per the initial studies, around 20 Tcf of gas is estimated as technically recoverable reserves in the Cambay basin. ONGC had drilled the country's first shale gas well in Jambusar in the October in 2013 to exploit the natural gas trapped within the shale formations located in Cambay basin.

Student Notes:

Methane Hydrate

Methane Hydrate is a cage-like lattice of ice inside of which are trapped molecules of methane, the chief constituent of natural gas. It is found in sea-bed that forms at low temperatures and high pressure. It is also found in onshore deposits in the permafrost of northern Canada and Russia. Heating the deposits or lowering the pressure will release gas from the solid. One litre of solid hydrate releases around 165 litres of gas.

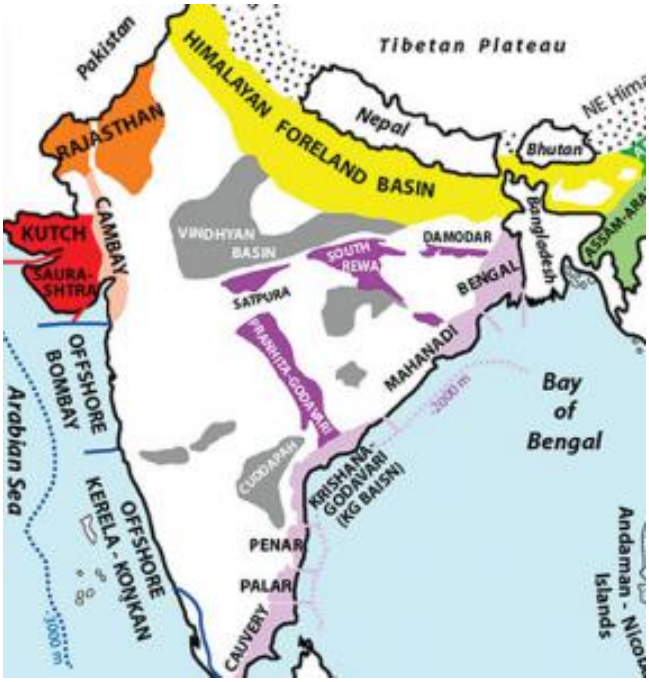


Figure 13: Potential Gas Hydrate reserves of India

India has some of the biggest methane hydrate reserves in the world. These are tentatively estimated at 1,890 trillion cubic metres. An Indo-US scientific joint venture in 2006 explored four areas: the Kerala-Konkan basin, the Krishna-Godavari basin, the Mahanadi basin and the seas off the Andaman Islands (figure 13). The deposits in the Krishna Godavari basin turned out to be among the richest and biggest in the world. The Andamans yielded the thickest-ever deposits 600 metres below the seabed in volcanic ash sediments.

3.5. Nuclear

Nuclear energy has emerged as a viable source in recent times. Important minerals used for the generation of nuclear energy are **uranium and thorium**. Uranium is a relatively common element in the crust of the Earth. It is a metal approximately as common as tin or zinc, and it is a constituent of most rocks and even of the sea. The table 14 gives some idea of our present knowledge of uranium resources. It can be seen that Australia has a substantial part (about 31 percent) of the world's uranium, Kazakhstan 12 percent, and Canada and Russia 9 percent each. Known uranium resources have increased almost threefold since 1975.

Recycled uranium and plutonium is another source for Uranium fuel, and currently saves 1500-2000 tU per year of primary supply, depending on whether just the plutonium or also the uranium is considered. In fact, plutonium is quickly recycled as MOX fuel, whereas the reprocessed uranium (RepU) is mostly stockpiled.

Re-enrichment of depleted uranium (DU, enrichment tails) is another secondary source. There is about 1.5 million tonnes of depleted uranium available, from both military and civil enrichment activity since the 1940s, most at tails assay of 0.25 - 0.35% U-235. Russian enrichment plants have treated 10-15,000 tonnes per year of DU producing a few thousand tonnes per year of natural uranium equivalent.

	tonnes U	percentage of world
Australia	1,661,000	31%
Kazakhstan	629,000	12%
Russia	487,200	9%
Canada	468,700	9%
Niger	421,000	8%
South Africa	279,100	5%
Brazil	276,700	5%
Namibia	261,000	5%
USA	207,400	4%
China	166,100	3%
Ukraine	119,600	2%
Uzbekistan	96,200	2%
Mongolia	55,700	1%
Jordan	33,800	1%
other	164,000	3%
World total	**5,327,200**	

Figure 14: Known Recoverable Resources of Uranium 2011

Global uranium mine production increased by over 25% between 2008 and 2010 because of significantly increased production in Kazakhstan, currently the world's leading producer. Global uranium production trend is shown in figure 15. Demand for uranium is expected to continue to rise for the foreseeable future. Although the Fukushima Daiichi nuclear accident has affected nuclear power projects and policies in some countries, nuclear power remains a key part of the global energy mix.

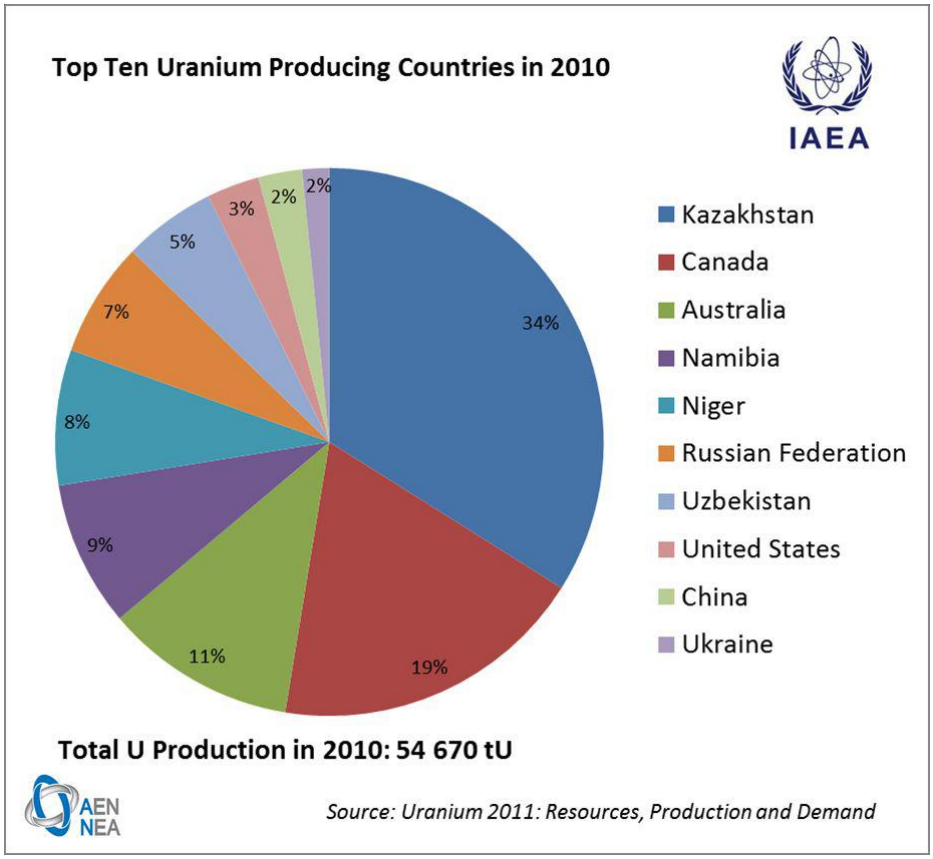


Figure 15: Top 10 Uranium producing countries (2010)

Student Notes:

Current usage of Uranium is about 68,000 tU/yr. Thus, the world's present measured resources of uranium (5.3 Mt) in the cost category around present spot prices and used only in conventional reactors, are enough to last for about 80 years.

Thorium as a nuclear fuel

Today uranium is the only fuel supplied for nuclear reactors. However, thorium can also be utilised as a fuel for CANDU (CANada Deuterium Uranium) reactors or in reactors specially designed for this purpose. Neutron efficient reactors, such as CANDU, are capable of operating on a thorium fuel cycle, once they are started using a fissile material such as U-235 or Pu-239. Then the thorium (Th-232) atom captures a neutron in the reactor to become fissile uranium (U-233), which continues the reaction.

Thorium is about 3.5 times more common than uranium in the Earth's crust. Present knowledge of the distribution of thorium resources is poor because of the relatively low-key exploration efforts arising out of insignificant demand. World distribution of Thorium reserves is shown in figure 16. India and Australia are believed to possess about 300,000 tonnes each; i.e. each country possessing 25% of the world's thorium reserves.

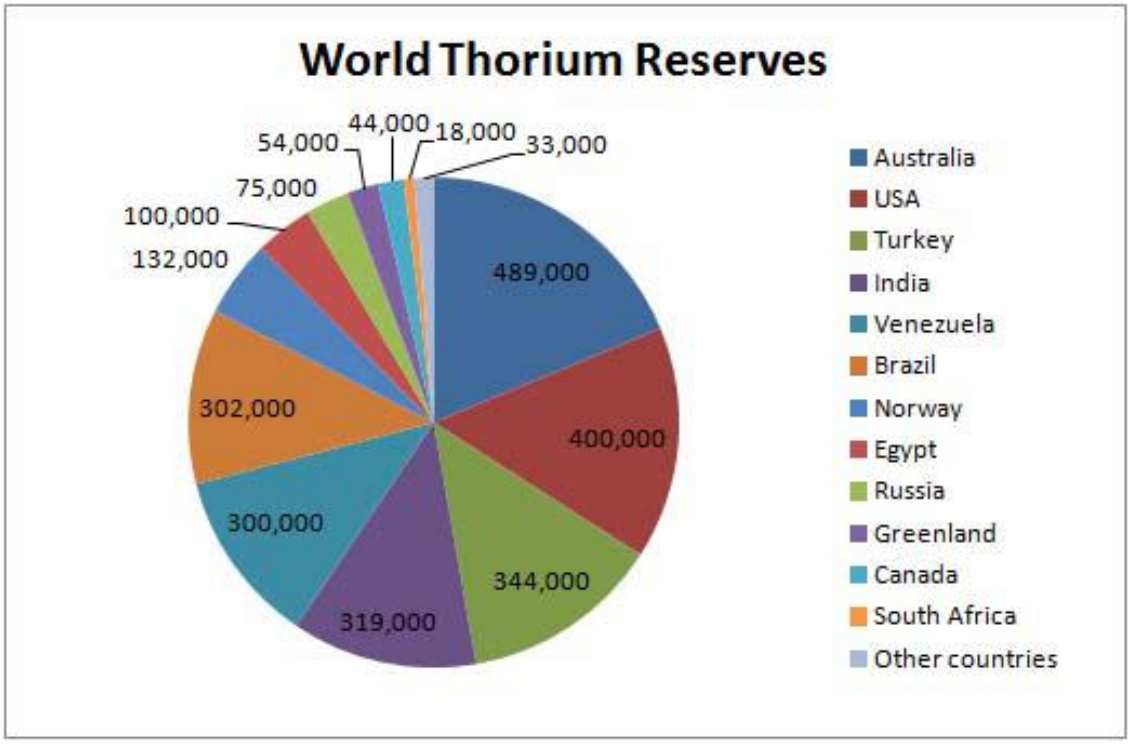


Figure 16: World Thorium reserves (in tonnes) (2005)

3.5.1. India

India has relatively modest reserves of uranium. India's uranium resources are modest, with 102,600 tonnes U (tU) as reasonably assured resources (RAR) and 37,200 tonnes as inferred resources in situ at January 2011. However, **department of atomic energy claims to have reserves of 1, 86, 653 tU in 2013.** Andhra Pradesh followed by Jharkhand and Meghalaya in that order is top state with largest uranium reserves.

With rise in number of reactors, India expects to import an increasing proportion of its uranium fuel needs. In 2013, India imported about 40% of her uranium requirements from France, Russia and Kazakhstan. India's Uranium mines are shown in figure 17. Ministry of Environment and Forest rejected the proposal of uranium mining in Mehgalaya keeping in view of the sentiments of the local people and a number of representations received from local civil society group. Following are the uranium mines in Jharkhand's Singhbhum zone:

Student Notes:

- Jaduguda Mine
- Bhatin Mine
- Turamdih Mine
- Bagjata Mine
- Narwapahar Mine
- Banduhurang Mine
- Jaduguda Mill
- Turamdih Mill
- Mohuldih Mine

Major areas which are currently under survey and exploration to augment uranium reserves in India include:

- Tummalapalle-Rachakuntapalle, Kadappa district, Andhra Pradesh
- Koppunuru and adjoining areas, Guntur district, Andhra Pradesh
- Rohil and adjoining areas, Sikar district, Rajasthan
- Wahkut and Umthongkut areas of West Khasi Hills district, Meghalaya
- Gogi, Yadgir district, Karnataka
- Singridungri-Banadungri, East Singhbhum district, Jharkhand and
- Bangurdih, Seraikela-Kharsawan district, Jharkhand.

Figure 17: Uranium occurrence and production centres in India

Indian interest in thorium is motivated by their substantial reserves. Department of Atomic Energy has established the presence of 10.70 million tonnes of Monazite ore, found in beach and river sand in the country, which contains 9,63,000 tonnes of Thorium Oxide (ThO2) in 2009. India Monazite contains about 9-10% of ThO2 and about 8,46,477 tonnes of thorium Metal can be obtained from 9,63,000 tonnes. In 2013, total Monazite reserves are estimated to be 11.93 million tonnes. Following is the state wise distribution:

State	Monazite (million tonne)
Odisha	2.41
Andhra Pradesh	3.72
Tamil Nadu	2.46
Kerala	1.90
West Bengal	1.22
Jharkhand	0.22
Total	11.93

Student Notes:

Thorium is mainly obtained from monazite and ilmenite in the beach sands along the coast of Kerala and Tamil Nadu (figure 18). World's richest monazite deposits occur in Palakkad and Kollam districts of Kerala, near Vishakhapatnam in Andhra Pradesh and Mahanadi river delta in Odisha.

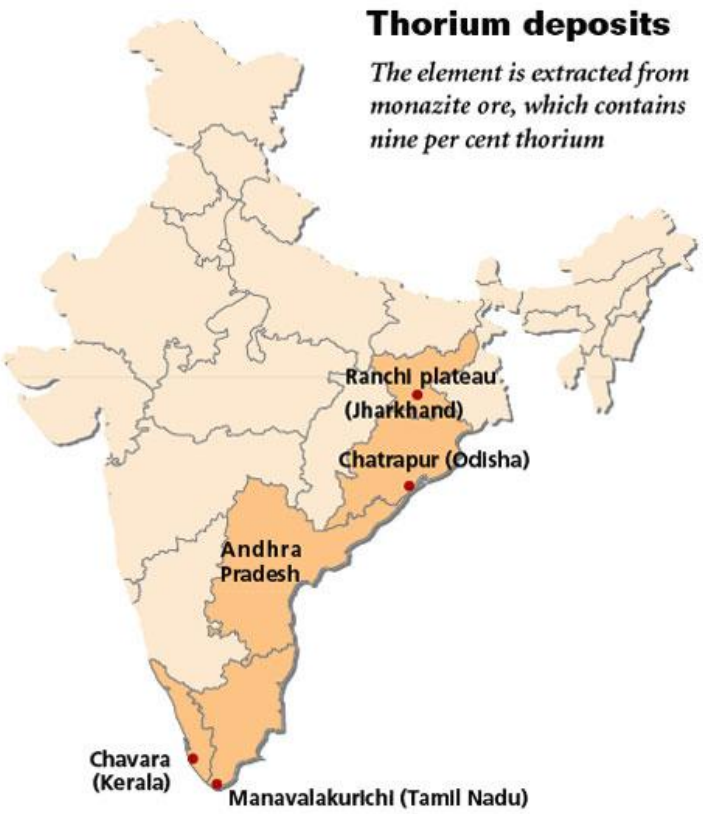


Figure 18: Thorium deposits, India

References:

[1] Types of coal

- **Lignite -** often referred to as **brown coal,** is a soft brown combustible sedimentary rock that is formed from naturally compressed peat. It is considered the lowest rank of coal due to its relatively low heat content. It has a carbon content of around 25-35%, a high inherent moisture content sometimes as high as 66%, and an ash content ranging from 6% to 19%. It is mined in Bulgaria, Kosovo, Greece, Germany, Poland, Serbia, Russia, Turkey, the United States, Canada, India, Australia and many other parts of Europe and it is used almost exclusively as a fuel for steam-electric power generation.
- **Bituminous coal** or **black coal** is a relatively soft coal containing a tarlike substance called bitumen. It is of higher quality than lignite coal but of poorer quality than anthracite. The carbon content of bituminous coal is around 60-80%; the rest is composed of water, air, hydrogen, and sulphur.
- **Anthracite** is a hard, compact variety of mineral coal that has a high luster. It has the highest carbon content, the fewest impurities, and the highest calorific content of all types of coal. The carbon content is between 92.1% and 98%. It is used mainly in power generation, in the metallurgy sector. Anthracite accounts for about 1% of global coal reserves,[4] and is mined in only a few countries around the world. China accounts for the majority of global production; other producers are Russia, Ukraine, North Korea, Vietnam, the UK, Australia and the US.

[2] Reserves are identified quantities of "in-place" minerals that are considered recoverable under current economic and technological conditions.

4. UPSC Prelim Previous Year Question

Student Notes:

1. The most important fishing grounds of the world are found in the regions where?(2013)
(a) Warm and cold atmospheric currents meet.
(b) Rivers drain out large amounts of freshwater into the sea.
(c) Warm and cold oceanic currents meet.
(d) Continental shelf is undulating.

2. Which of the following is/are the characteristic/characteristics of Indian coal? (2013)
1. High and content
2. Low sulphur content
3. Low ash fusion temperature

Select the correct answer using the codes given below:
(a) 1 and 2 only (b) 2 only
(c) 1 and 3 only (d) 1, 2 and 3

3. Consider the following statements:
1. Natural gas occurs in the Gondwana beds.
2. Mica occurs in abundance in Kodarma.
3. Dharwars are famous for petroleum.

Which of the statements given above is/are correct? (2013)
(a) 1 and 2 (b) 2 only
(c) 2 and 3 (d) None

4. With reference to two non-conventional energy sources called 'coalbed methane' and 'shale gas', consider the following statements: (2014)
1. Coalbed methane is the pure methane gas extracted from coal seams, while shale gas is a mixture of propane and butane only that can be extracted from fine-grained sedimentary rocks.
2. In India, abundant coalbed methane sources exist, but so far no shale gas sources have been found.

Which of the statements given
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

5. In which of the following regions of India are shale gas resources found?
1. Cambay Basin
2. Cauvery Basin
3. Krishna-Godavari Basin

Select the correct answer using the code given below. (2016)
(a) 1 and 2 only (b) 3 only
(c) 2 and 3 only (d) 1, 2 and 3

6. Consider the following statements:
1. In India, State Governments do not have the power to auction non-coal mines.
2. Andhra Pradesh and Jharkhand do no have gold mines.
3. Rajasthan has iron ore mines.

Which of the statements given above is/are correct? (2018)
(a) 1 and 2 (b) 2 only
(c) 1 and 3 (d) 3 only

Student Notes:

5. UPSC Mains Previous Year Question

1. With growing scarcity of fossil fuels, the atomic energy is gaining more and more significance in India. Discuss the availability of raw material required for the generation of atomic energy in India and in the world. (2013)
2. It is said that India has substantial reserves of shale oil and gas, which can feed the needs of the country for quarter century. However, tapping of the resource does not appear to be high on the agenda. Discuss critically the availability and issues involved. (2013)
3. Critically evaluate the various resources of the oceans which can be harnessed to meet the resource crisis in the world. (2014)
4. How does India see its place in the economic space of rising natural resources rich Africa? (2014)
5. The states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand reaching the limits of their ecological carrying capacity due to tourism. Critically evaluate. (2015)
6. India is well endowed with fresh water resources. Critically examine why it still suffers from water scarcity. (2015)
7. What are the economic significances of discovery of oil in Arctic Sea and its possible environmental consequences? (2015)
8. South China Sea has assumed great geopolitical significance in the present context. Comment. (2016)
9. Present an account of the Indus Water Treaty and examine its ecological, economic and political implications in the context of changing bilateral relations. (2016)
10. "In spite of adverse environmental impact, coal mining is still inevitable for development." Discuss. (2017)
11. Why is India taking keen interest in resources of Arctic Region? (2018)
12. Define blue revolution, explain the problems and strategies for pisciculture development in India. (2018)
13. Can the strategy of regional resource-based manufacturing help in promoting employment in India? (2019)
14. Discuss the factors for localisation of agro-based food processing industries of North-West India. (2019)

6. Vision IAS Previous Years Mains Questions

1. What do you understand by social forestry? Highlight its socio-economic significance for India.

Approach:

- Start with a brief description of social forestry.
- Also, highlight types of social forestry.
- Discuss its socio-economic significance for India.

Answer:

Social forestry refers to the protection and management forests and afforestation on barren lands thereby assisting environmental, social and rural development. The National Commission on Agriculture has classified social forestry into three categories:

- **Urban forestry** - It relates to the raising and management of trees on public and private lands **in and around urban centres** such as parks, roadside avenues etc.
- **Rural forestry** - It emphasizes on the promotion of **agroforestry and community-forestry**.
    - **Agro-forestry** - It is the raising of **trees along with agriculture crops** on the same agricultural land including waste patches.

Student Notes:

- **Community forestry** - It involves the raising of trees **on public or community land** such as the village pasture, roadside, strips along railway lines, and schools etc.

- **Farm Forestry** - It refers to raising of trees for commercial and non-commercial purposes **by farmers on their farm lands**.

Socio-economic significance

- It would provide the additional source of income to farmers and increase the livelihood opportunities in rural areas.
- Community forestry promotes the interest of the landless classes by associating them in tree raising and thus, get those benefits which otherwise are restricted for landowners.
- Further, raising of trees for commercial purposes would increase the supply of raw material like food, fodder, fuel, timber and fruit for agri-businesses.
- It would have benefits in terms of recreational and amenity values or maintenance of a rural way of life.
- It encourages people to live in harmony with the forests; encourages adoption of sustainable agricultural practices, and therefore, enable us to deal with the climate changes.
- It also improves quality of life of people by moderating the environment of the place. For e.g. Urban forestry would help reduce the growing number of heat islands etc.

Recognizing the important of social forestry, government brought National Agroforesty Policy in 2014. Also, certain states such as Gujarat have also taken some initiatives in this regard. It started Social Forestry Programme in 1969-70 and Social Forestry divisions were established. Various such initiatives should be taken along with grassroot participation for realizing the potential of social forestry in India.

2. Discuss the opportunities and challenges for India in harnessing the resources of the Indian Ocean Region.

Approach:

- Giving a brief introduction, discuss the opportunities that resources of the Indian Ocean Region provide for India.
- Discuss the challenges that are present in harnessing the potential.
- Conclude with a way forward.

Answer:

The Indian Ocean Region (IOR) comprises the Indian ocean and its littoral countries. India has a prominent geographical presence with a long coastline, several islands and is situated at the tip of sea-lanes connecting Northern Atlantic with Asia-Pacific.

The IOR presents numerous opportunities for India, such as:

- **Energy resources:** 40% of the world's offshore oil production takes place in the Indian Ocean basin which can be improved further to its full potential with the discovery of new oil fields. Further, it can theoretically provide nearly 12500 MW of Tidal Energy and 180,000 MW of Ocean Thermal Energy Conversion.
- **Aquaculture and fishing:** Aquaculture in the region has grown 12 fold since 1980 and its potential is still untapped. Fishing in the IOR now accounts for 15% of the world's total. Further, according to an FAO report, global fishing is reaching its natural limitation but the Indian Ocean may be able to sustain increase in production and demand.

Student Notes:

- **Mineral resources:** Sizeable quantities of polymetallic nodules containing mineral resources like nickel, cobalt, iron, manganese, copper, gold, zinc, titanium, rare earth materials etc. are present on the sea bed.
- **Geopolitical opportunities:** About half of the world's container shipments, one-third of the world's bulk cargo traffic and two-thirds of oil shipments pass through it annually. Three quarters of this traffic is headed for destinations beyond the region, thus increasing the importance of India in ensuring safe and free sea lanes of transportation.

However, despite huge potential, **several challenges exist for India to harness the potentials of abundant natural resources present in the region:**

- The Indian Ocean Region faces common pressing challenges of increasing urbanization, industrialization and migration etc. resulting in over-exploitation of natural marine resources.
- Developing technology for deep sea mining is a challenging task.
- Security threats in the Indian Ocean Region due to pirates are a major challenge. Also, developing comprehensive and effective monitoring, control and surveillance systems in the region would be challenging.
- Plastic pollution and global warming are threatening the maritime resources like fish, corals etc. and their sustainability.
- Indian Ocean Region is a strategically important location and presence of global powers like China, USA, etc. in the region may create problems for India's objective.
- Suitable international cooperation with several littoral countries will be a tedious task for India as divergent sovereign laws, regional arrangements and international laws add to the existing challenges.

India can overcome the above issues by focusing on developing sound policies related to the region covering all aspects of maritime resources including required technology. Further, India should seek international cooperation based on a sustainable and inclusive framework. Initiatives like SAGAR and Indian Ocean Rim Associations are steps in this direction.

3. Analyse the phenomenon of 'Resource Curse', by giving adequate examples from around the world as well as India.

Approach:

- Introduce by explaining the meaning of 'curse of resources'.
- Discuss in brief the impact of the above.
- Give appropriate examples wherever necessary.
- Conclude by giving a way forward.

Answer:

The 'curse of resources' is a paradoxical situation in which countries with an abundance of non-renewable natural resources experience stagnant economic growth or even economic contraction. It is also known as the "paradox of plenty." This is particularly the case with oil producing countries like Venezuela. Reasons such as the manner in which resource income is spent, system of government, institutional quality, early vs. late industrialization etc. all have been used to explain this.

Impact of 'curse of resources':

- **Dutch disease**: Increase in the economic development of a specific sector (ex-natural resources) and a decline in other sectors.

Student Notes:

- **Revenue volatility:** This is because prices of natural resources are subject to wide fluctuation.
- **Enclave effects:** Economic diversification may be delayed or neglected by the authorities in the light of the temporarily high profits from a specific sector.
- **Crowding out of human capital:** Short term gains from natural resource sector may tend to neglect education because they see no immediate need for it.
- **Violence and conflict:** Vulnerability to conflicts increases due to undermining of the quality of governance and economic performance. Ex- Iraq's invasions of Iran and Kuwait; Libya's repeated incursions into Chad, etc.

Examples from India:

States like Orissa, Jharkhand and Chhattisgarh are rich in productive minerals. These three states together account for 70 per cent of India's coal reserves, 80 percent of high-grade iron ore, 60 percent of bauxite and almost all the chromites reserves. They are also rich in forest reserves.

Over dependence on mining has not allowed the development of agriculture and other sectors in these states. Further, the benefits of resource extraction fails to reach all the sections of society, promotes corruption and illegal regulations. Also, these regions continue to bear the brunt of Left Wing Extremism.

However, these regions have high prospects for future developments. With the efforts like bringing positive institutional change, capacity building, international cooperation to curb corruption, economic diversification, enhancing social cohesion, etc. can bring a positive change in these regions.

4. Identify the major Uranium reserves in the world and the countries from where India sources it. What measures are required to ensure supply security of fuel for nuclear plants in the country?

Approach:

- Identify the major uranium reserves in the world
- Mention the countries from where India sources its Uranium
- Provide measures which are required to ensure supply-security of nuclear fuel in India.

Answer:

Uranium is one of the atomic minerals contributing to natural terrestrial radioactivity. Uranium reserves are reserves of recoverable uranium, regardless of its isotopes.

Major Uranium reserves in the world:

- Australia has almost 1/3rd (largest) Uranium reserves of the world. Most of Uranium is concentrated in the Olympic dam in Northern Territory and Ranger mines in Southern Australia. Kazakhstan is among the world's largest Uranium producer with significant deposition in Chu-Sarysu basin, Syrdarya basin and Akmola region.
- Russia has Uranium deposits in Trans-Ural district, South-Eastern Siberia and Trans-Baikal region.
- Canada is the second largest producer of Uranium with high grade deposits largely concentrated in the Athabasca Basin of Northern Saskatchewan province. The McArthur River mine is the world's biggest uranium producing mine.
- Further South Africa, Niger, Brazil, China, Namibia, Mongolia, Uzbekistan, and Ukraine also possess around 2% or more of world's uranium reserves.

Student Notes:

In India, Uranium is extracted mainly from Singhbhum, Jharkhand (Jadugoda, Banduhurang). Low grade Uranium is also found in Cuddapah basin, Bhima basin, South-West Khasi Hills and North-Delhi fold belt. The largest source of uranium is the monazite sands which occur in some places in Bihar and on east and west coasts with the largest concentration on the Kerala coast.

However due to quality issues, less availability, high cost of extraction and resistance faced by locals, India has to import its major Uranium requirements from Kazakhstan, Russia, Canada and Australia.

In recent times, France and Namibia are facing resistance from other countries as India is not a member of NSG and with Uzbekistan transportation issues are getting surfaced. According to the Department of Atomic Energy, a stockpile of 15,000 tonnes of uranium is required for achieving supply-security of fuel for nuclear plants in the country. Therefore, following measures should be taken in view of these challenges:

- Creating strategic Uranium Reserves.

  and conducting survey for new Uranium mines.
- Reducing extraction cost from deep underground mines through technological breakthrough.
- Diversifying nuclear trade with countries which are providers of reactors, fuel or other allied nuclear infrastructure such as Nigeria and Iran.
- Creation of enrichment facilities to process Uranium in intermediate forms.
- Effective lobbying at Uranium club and NSG.
- Creation of a national energy supply risk assessment and management framework.

Overall, nuclear energy is a good option for India to promote low carbon growth and for overall energy security. Therefore, along with these measure, India must also try to refine the technology which uses indigenous Thorium in order to ensure long term availability of fuel for nuclear plants.

5. Explain the relationship between raw materials and location of industries. How are globalisation and technological advancements changing this relationship?

Approach:

- Introduce by giving a brief account of relationship between raw materials and the location of industries.
- Discuss in brief the effect of globalization and the technological advancements on this relationship.
- Give appropriate examples wherever necessary.
- Conclude on the basis of the above points.

Answer:

Industrial locations are primarily driven by costs. Merely high endowment of resources does not cause industry to be attracted to an area. It is the comparative advantages that a place enjoys that actually attracts industries. These are influenced by several factors like access to raw materials, power, market, capital, transport and labour, etc. It is economical to locate the manufacturing industries at a place where cost of production and delivery cost of manufactured goods to consumers are the least.

There is a strong relationship between availability of raw material and location of the industry as seen below:

- 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. For example, Iron and steel industries, coal industry, etc.

Student Notes:

- Industries based on **raw materials which loses weight in the process** of manufacturing are located near source of raw material. For example, Sugar mills, etc.
- Industries based on raw materials which cannot be transported over long distances because of **their perishable nature** are located near source of raw material. For example, Agro-processing and dairy products.
- **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. So these industries are located closer to each other.
- Industries based on **raw materials which cannot bear high transport cost** are located near source of raw material. For example: Cotton textile industry, etc.

However, at present, this trend seems to be changing due to the effects of globalization and the technological advancements in the following manner:

- **Decreased transportation cost due to technological advances**: This has changed the above relationship and now a days industries may establish themselves away from the source of raw material.
- **Market and profit orientation**: Industries are being set up near the market places due to increasing demand for products and also increasing trend of demand for customization of products. For example: Mobile making industry, etc.
- **Improved backward linkages and cold chain storage**: Technological advancement has made it possible to transport raw materials having lesser shelf-life to long distances without getting perished.
- **State policies and incentives**: In era of globalization, states try to incentivize industries and attract investment which has influenced the location of industries irrespective of availability of raw material. For example: Free trade agreements, tax exemptions, customs duty, etc.
- **Creation of artificial environment**: Technological advancement has enabled creation of artificial environment and facilities required for production of desired product as done in natural environment. For example: Humid condition required for cotton textile industry is being artificially created by using technology.
- **Expansion of industries**: Due to globalization, a single industry is setting up its branches at different places without having need to set up an industry at the place of raw material always.

Globalization is dismantling the trade barriers between nations. Also, Industries are becoming footloose i.e losing their locational dependence on raw material and with the leveraging of technology, they are less and less dependent on raw materials only.

6. Giving examples, examine the importance of different factors of location of Pharmaceutical industry in India. What are the ways in which the recent changes in tax architecture may affect it?

Approach:

- Give a brief factual background of the current position and potential of the pharmaceutical industry in India.
- By citing examples, describe the factors responsible for the location of pharmaceutical industry in India.
- Explain as to how recent changes in tax infrastructure such as Goods and Services Tax would likely impact this sector.

Answer:

Student Notes:

The Indian Pharmaceutical Industry ranks 4th in terms of volume and 13th in terms of value across the world. It has created a niche for itself in generic drugs market, biotechnology, and novel drug delivery systems globally.

The pharmaceutical industry is an example of footloose industry (i.e. it does not require specific local resources) and hence it can be established wherever the feasibility criteria is met on the basis of following factors:

- **Availability of raw materials** ensures a constant supply and reduction in operational cost. For instance, proximity to the petrochemical hubs located on the Western Coast of India.
- **Nearness to the market/transportation networks**: For example, preponderance of the pharmaceutical industry in the western region of India due to its proximity to ports such as Kandla, which facilitate easy export of generic drugs to Africa and Europe.
- **Availability of both skilled and unskilled labour** at cost effective rates is a prerequisite for the pharmaceutical industry.
- **Suitability of land and climate**: extremely hot, humid, dry or cold climate are not suitable for the establishment of pharmaceutical plants.
- **Environmental impact, waste disposal and safety requirements**: need to be given due consideration to prevent man-made disasters like Bhopal Gas tragedy.
- **Easy availability of capital and favourable state policies**: For example, stable policies of state governments such as in Gujarat and low taxation rates of Himachal Pradesh have attracted various pharmaceutical industries.
- **Constant supply of power at cheap rates**: For instance, frequent power cuts in in Himachal Pradesh have compelled companies to relocate towards states providing regular power supply like Gujarat.
- **Quality of water**: For instance, pristine quality of water available in hilly states is required for formulations of active pharmaceutical ingredients (APIs).

The Indian pharmaceutical industry is expected to grow over 15% per annum against expected average global rate of 5% per annum between 2015 and 2020. The Indian pharmaceutical exports are also expected to grow by 30% by 2020 as per the Pharmaceuticals Export Promotion Council of India.

In this respect, the implementation of Goods and Services Tax (GST) is expected to be a game changer. Although there are concerns related to drug pricing, exemptions and compliance standards, yet it is going to be a promising development for the industry in the medium to long run in the following manner:

- It would create tax neutral inter-state transactions between two parties, thereby reducing the dependency on multiple states and increasing the focus on regional hubs.
- It is expected to bring in efficient supply chain management, which will reduce the final costs of the drugs considerably. This will also result in increased forecast accuracy, better and improved order-fulfillment cycle time.
- Cascading taxes across different states like Octroi in Gujarat, Maharashtra and Punjab will no longer exist.
- Provision of tax credit on duty levied on import of costly machinery and equipment is expected to bring down the cost of technology.

Student Notes:

7. Highlight the key factors that need to be considered in deciding the location of nuclear power plants. Also, explain the difficulties India faces in utilizing the large reserves of thorium as part of its civil nuclear programme.

Approach:

- Introduce by stating the relevance of nuclear power in India's energy mix.
- Discuss various location and non- location factors – availability of land, technology, water availability, disaster-secure etc.
- Highlight the challenges India faces in utilization of thorium reserves

Answer:

India's dependence on imported energy resources poses a challenge to satisfying rising energy demand, with nuclear power as a potential indigenous solution. The union cabinet recently approved 10 new nuclear power plants installation.

The pollution caused by nuclear power plants and the ever-present danger of melt down (e.g. Fukushima) makes the plants sensitive to location. The factors are:

- Remoteness – away from densely populated areas.
- Availability of large area of land for power plants and waste disposal.
- Proximity to water source – as large quantities of water are required as coolant, moderator etc.
- Disaster-secure areas – to minimize vulnerability of nuclear fall-out.
- Non- location factors – Technology, skilled manpower, capital, adequate demand for power.

India has only 1% of the world's uranium reserves, but is blessed with the largest reserves of thorium. The challenges to its utilization are:

- Thorium cannot be used directly, as it's not fissile. It needs to undergo transmutation to convert to a fissile isotope Uranium – 233, in the presence of other fissile materials. Therefore, India has a three-stage nuclear power program where in, the first two stages are critical to build up reserves of fissile materials like plutonium to be used in the 3rd stage with thorium. Thus shortage of uranium fuel that is needed to convert fertile fuel into fissile fuel that can undergo sustained chain reaction is the biggest challenge.
- India's second stage of Fast Breeder reactors is still in its infancy, and India has limited access to fissile material from other nations due to issues like non-membership of NSG and non-signatory of NPT. According to experts, India will need many more Fast Breeder Reactors and at least another four decades to build up sufficient fissile material inventory.
- The development of reactor technology i.e. the Advanced Heavy Water Reactor (stage III) poses another challenge.

The Indian growth story will see a commensurate increase in power demand. The thorium reserves present a challenge as well as an opportunity for the Indian nuclear program. But to harness this potential reserve India needs to positively exploit its civil nuclear agreements with foreign powers to get continuous supply of the fissile material.

Student Notes:

8. Bring out the importance of focussing on energy efficiency for achieving energy security in India. What steps have been taken by the government in this regard?

Approach:

- Introduce by mentioning the current status of energy in India.
- Highlight its importance for achieving energy security.
- Mention the steps taken by government in this regard.
- Conclude briefly.

Answer:

Energy is vital for development and prosperity of any economy. India has a per-capita energy consumption of only about one-third of the global average. Moreover, India houses nearly 304 million people without access to electricity. Therefore, the demand for energy would increase substantially in the future.

In order to meet this demand, it is important to not only increase electricity-generating capacity, preferably through renewable sources but also use energy efficiently. With limited capacity to improve the generation capacity, energy efficiency becomes central to energy security in India. Energy efficiency essentially means using lesser amount of energy while producing a given amount of output.

The importance of energy efficiency can be gauged from the following factors:

- Using energy efficiently results in **decrease in quantum of energy required** in the country. It helps in **lowering energy intensity** growth of the country, which is regarded as an important challenge for ensuring energy security.
- This also delays investments in both network and generation capacity thereby leading to **more savings in costs**. It would also lead to **less dependence on imports**.
- Energy efficiency also **ensures sustainable use of energy** as leads to reduction in GHG and other emissions.

It has been estimated that more than 25,000 MW can be saved by implementing end-use energy efficiency and demand side management measures throughout India.

Recognizing the benefits of energy efficiency, the government has been promoting measures for energy efficiency. Some of the steps taken in this regard are:

- The **institutional and legal framework** for energy efficiency has been strengthened through the **Energy Conservation Act in 2001**, which created the **Bureau of Energy Efficiency (BEE).**
- BEE **started the standards and labelling scheme** which aimed to provide the consumer an informed choice about the energy saving and thereby the cost saving potential of the relevant marketed product.
- **The Energy Conservation Building Code (ECBC)** was developed by the government for commercial buildings that sets the minimum energy standards for these buildings.
- The National Mission for Enhanced Energy Efficiency (NMEEE) aims to strengthen the **market for energy efficiency** by creating **conducive regulatory and policy regime** and has envisaged fostering **innovative and sustainable business models** to the energy efficiency sector. One of its components- **Perform, Achieve and Trade has been able to** provide a market based mechanism to incentivize adoption of energy efficiency measures**.**
- **UJALA and Street Light National Programme** aim to promote the use of energy efficient LED lamps.

According to a BEE study, the energy efficiency programmes led to a total cost savings worth nearly Rs.53,000 crore in 2017-18 and contributed in reducing 108.28 Million

tonnes of CO_2 emission. Going forward, the government should also address challenges like limited technical capabilities and difficulties in obtaining finances for energy saving projects for realizing the true potential of energy efficiency in India.

Student Notes:

9. Enumerating the factors that determine a nation's energy-mix, comment on the need for having a diversified fuel basket for meeting India's future energy demands.

Approach:

- Discuss the factors that determine a nation's energy-mix.
- Analyze the need for having a diversified fuel basket for meeting India's future energy demands.
- Suggest strategies to fulfil the objectives of energy security in India.

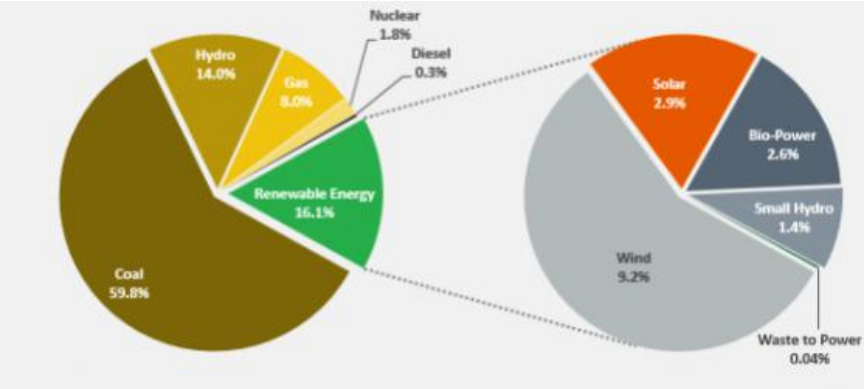
Answer:

"Energy mix" refers to the combination of the various primary energy sources used to meet energy needs in a given geographic region. It includes fossil fuels (oil, natural gas and coal), nuclear energy, non-renewable waste and the many sources of renewable energy (wood, biofuel, hydro, wind, solar, geothermal, heat from heat pumps, renewable waste and biogas).

The factors that determine a nation's energy mix are:

- **Supply**: availability of usable resources domestically or the possibility of importing them. For example, energy from coal, gas and oil quickly responds to the market demand.
- **Demand**: varies with type of activity, economy, technology and different efficiency measures. For example, transport sector is heavily dependent on oil in India.
- **Storage**: represents 'energy inventory', keeping into account emergency supply.
- **Technological changes**: improvement in technology necessitate shift towards different energy sources. For example, coal plant conversions to natural gas to avoid scrubbing technology costs or the usage of nuclear technology as a recent measure in India.
- **Global factors**: variety of geopolitical factors affects energy mix such as political stability in the source regions, trade embargoes with nations etc. .
- **New discoveries**: For example, in USA due to massive growth in shale gas production, the share of oil is bound to come down in the future energy mix
- **Climate change**: For example, India's energy diversification is influenced by the National Action Plan on climate change and encourages the usage of renewable energy.
- **Policy choices** determined by historical, economic, social, demographic and environmental factors.

Current scenario in India:



In light of the above, diversification of energy sources is required as:

- **Increased per-capita consumption**: The per capita energy consumption in India has reached 1075 kWh in 2015-16 which is expected to double in another 7-8 years.
- **Growing price competitiveness:** Recently the renewable energy sector has witnessed tremendous advancement especially due to the technology leap enabled by innovation.
- **Self Reliance:** Diversification of energy can reduces dependence on foreign energy imports with domestically produced electricity.
- **Feasibility:** India is better placed for energy diversification. Each source has strengths that can compensate for the other's weaknesses.

As a fast growing economy, energy is central to achieving India's development ambitions. Thus, diversification of energy supply is imperative to strengthen the energy security of a nation.

Student Notes:

10. What are various techniques of recovering energy from waste? Highlight the potential and challenges associated with Waste to Energy plants in India.

Approach:

- Briefly, write about the Waste-to-Energy process.
- Discuss the various techniques of recovering energy from waste.
- Highlight the potential and challenges associated with waste to energy plants in India.
- Conclude answer by suggesting a way forward.

Answer:

Waste-to-Energy (WTE) is an energy generation process wherein waste is treated to generate energy in the form of electricity or heat. These processes generate electricity or heat directly through combustion or produce a combustible fuel such as methane, methanol, ethanol or synthetic fuels.

Various techniques can be employed to recover energy from waste such as:

- **Incineration:** In this technique, municipal solid waste, which is used as a fuel, is burnt with high volumes of air to form carbon dioxide and heat. Further, these hot gases are used to make steam, which is then used to generate electricity.
- **Gasificatio**n: In this process, organic or fossil fuel-based carbonaceous materials are converted into carbon monoxide, hydrogen and carbon dioxide. It is done by reacting the material at high temperatures (>700'C), without combustion, with a controlled amount of oxygen and/or steam. Then, syngas produced by gasification can be turned into higher-value commercial products.
- **Pyrolysis:** It involves the application of heat with no added oxygen in order to generate oils and/or syngas (as well as solid waste outputs) and requires more homogenous waste streams.
- **Bio-methanation:** It is a process by which organic material is microbiologically converted under anaerobic conditions to biogas. It involves fermenting bacteria, organic acid oxidizing bacteria, and methanogenicarchaea.

The waste to energy plants has the capacity to produce electricity and have a huge potential in India. According to the Ministry of New and Renewable energy, the solid waste generated from cities/towns in India has a potential to generate power of approximately 500 MW, which can be enhanced to 1,075 MW by 2031 and further to 2,780 MW by 2050.

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But achieving this level requires dealing with following challenges:

- **Low Calorific Waste**: In India, municipal waste is often not segregated properly. It has a very high biodegradable (wet) waste ranging between 60 and 70 per cent of the total, compared with 30 per cent in the West. This gives our waste high moisture content and low calorific value.
- **High Toxic Waste:** Incinerators develop toxic ash or slag, containing heavy metals and gas pollutants which are toxic (corrosive impact) and pollute underground water.
- **Expensive power:** Compared to Rs 3-4 per kWh from coal and solar plants, WTE plants sell electricity at about Rs 7/kWh.
- **Lack of Finance for Urban Local Bodies (ULBs**): It affects the institutional capacity necessary for integrated management of municipal solid waste, which requires investments for WTE projects.
- **Other Challenges** include irregular and inadequate quantity of supply, non-payment of the agreed fee and non-marketability of waste processed projects, including power.

Therefore, to utilize the benefit of these technologies it is important to ensure proper collection and segregation of waste. Further, encouraging the private sector can help bring more efficiency and effectiveness in power generation through waste.

Additionally, the participation of civil society can play a key role in waste minimization and better management through the implementation of **the'5R' Concept: reduce, reuse, recover, recycle and remanufacture.**

MINERAL RESOURCES & MANUFACTURING INDUSTRIES

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1. Mineral and Energy Resources

Student Notes:

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. It has been estimated that nearly 100 minerals are known to be produced and worked in India. The country has fairly abundant reserves of coal, iron and mica, adequate supplies of manganese ore, titanium and aluminium, raw materials for refractory and limestone; but there is deficiency in ores of copper, lead and zinc. There are workable deposits of tin and nickel. India earns a lot of foreign exchange via export of a large variety of minerals such as iron ore, titanium, manganese, granite etc. while at the same time India has to depend upon imports to meet her requirements of some other mineral sources such as copper, silver, nickel, cobalt, zinc, lead, tin, mercury etc. The mineral resources in India are present in the peninsular part of the country. The vast alluvial plain tract of north India is devoid of minerals of economic use. The mineral resources provide the country with the necessary base for industrial development.

1.1. Types of Mineral Resources

On the basis of chemical and physical properties, minerals may be grouped under two main categories of metallic and non-metallic minerals.

Metallic minerals are the sources of metals. Metallic minerals can be further divided into two class- *ferrous minerals* (which have iron content) like iron, nickel, cobalt, tungsten, manganese etc. and *non-ferrous minerals* (which don't have iron content) like copper, bauxite, silver, gold etc.

Non-metallic minerals can be divided into **fuel minerals** (which are organic in origin) like coal, petroleum etc. and **other non-metallic minerals** like limestone, graphite etc. Minerals have certain characteristics. These are unevenly distributed over space. There is inverse relationship in quality and quantity of minerals i.e. good quality minerals are less in quantity as compared to low quality minerals. All minerals are exhaustible over time and it takes long to develop geologically and they cannot be replenished immediately at the time of need.

1.2. Distribution of Minerals in India

Most of the metallic minerals in India occur in the peninsular plateau region in the old crystalline rocks. Minerals are generally concentrated in three major belts in India. There are some sporadic occurrences here and there in isolated pockets. These belts are:

1.2.1. The North-Eastern Plateau Region

This belt covers Chota Nagpur (Jharkhand), Odisha Plateau, West Bengal and parts of Chhattisgarh. It is the richest mineral belt in India. It has variety of minerals viz. iron ore, coal, manganese, bauxite, mica. The Chota Nagpur plateau is also known as mineral heart land of India.

1.2.2. The Central Belt

This belt encompassing parts of Chhattisgarh, Madhya Pradesh, Andhra Pradesh and Maharashtra is the second largest mineral belt in the country. Large deposits of manganese, bauxite, limestone, marble, coal, mica, iron ore are available here.

1.2.3. The South-Western Plateau Region

This belt extends over Karnataka, Goa and contiguous Tamil Nadu uplands and Kerala. This belt is rich in ferrous metals and bauxite. It also contains high grade iron ore, manganese and limestone. This belt packs in coal deposits except Neyveli lignite. It does not have mica and copper deposits.

Student Notes:

1.2.4. The North-Western Region

This belt extends along Aravali in Rajasthan and part of Gujarat and minerals are associated with Dharwar system of rocks. This belt has developed recently and is gradually becoming a productive region holding great promise for mining of the nonferrous metals. Copper, zinc has been major minerals. Rajasthan is rich in building stones i.e. sandstone, granite, marble. Gypsum and Fuller's earth deposits are also extensive. Dolomite and limestone provide raw materials for cement industry.

1.3. Ferrous Minerals

Ferrous minerals form an important part of mining activity in India and provide base to metallurgical industries in India. Our country is well-placed in respect of ferrous minerals both in reserves and production.

1.3.1. Iron Ore

Iron is a metal of universal use. India has the largest reserve of iron ore in Asia. It is used for manufacturing articles from safety pins to ships. It is a durable and cheap metal which can be moulded in different forms and can be mixed with other metals to form alloys. Iron is not found in pure form. It is often mixed with lime, magnesium, phosphorous, silicon, etc. In India, we get four main types of iron ore, which are as under:

Haematite: It is also known as *red-ochre*, as it is reddish in colour. The iron contents in this type ranges from about 60 to 70 per cent. Most of the iron ore reserves in India belong to this type.

Magnetite: It is the best quality of iron ore and contains more than 70 per cent of the iron contents. The colour of the ore is dark brown to blackish and is known as *black ore.* It has magnetic properties.

Limonite: It is yellow or light brown in colour and the iron contents ranges from about 40 to 60 per cent. It is called hydrated iron oxide, when the iron ore in mixed with oxygen and water. Its mining is easier and cheaper.

Siderite: It is an inferior variety of iron ore and has many impurities. The iron contents ranges from about 20 to 40 per cent. It is also called *iron carbonate*.

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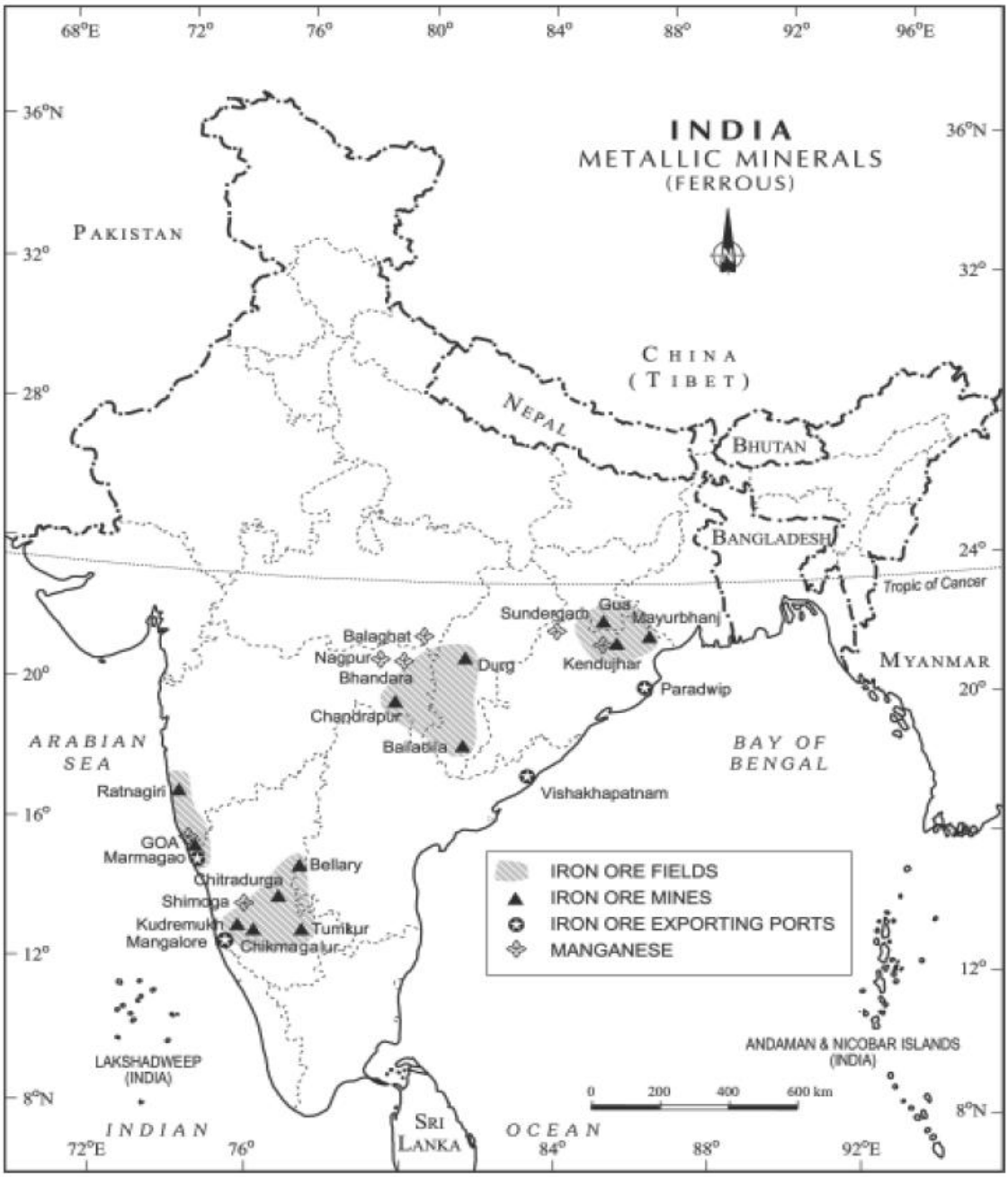


About 95 per cent of total reserves of iron ore are located in the States of Odisha, Jharkhand, Chhattisgarh, Karnataka, Goa, Andhra Pradesh and Tamil Nadu. In ***Odisha***, iron ore occurs in a series of hill ranges in Sundergarh, Mayurbhanj and Jhar. The important mines are Gurumahisani, Sulaipet, Badampahar (Mayurbhaj), Kiruburu (Kendujhar) and Bonai (Sundergarh). In ***Jharkhand*** has some of the oldest iron ore mines and most of the iron and steel plants are located around them. Important mines such as Noamundi and Gua are located in Poorbi and Pashchimi Singhbhum districts. Dalli, and Rajhara in Durg are other important mines of iron ore. In ***Karnataka***, iron ore deposits occur in Sandur-Hospet area of Bellary district, Baba Budan hills and Kudremukh in Chikmagalur district and parts of Shimoga, Chitradurg and Tumkur districts. The districts of Chandrapur, Bhandara and Ratnagiri in ***Maharashtra***, Karimnagar, Warangal, Kurnool, Cuddapah and Anantapur districts of ***Andhra Pradesh***, Salem and Nilgiris districts of ***Tamil Nadu*** are other iron mining regions. ***Goa*** has also emerged as an important producer of iron ore.

Student Notes:

India is the fifth largest exporter of iron in the world. Increasing demand of iron ore in domestic market has adversely affected the export performance of the sector. About half of the total production of iron ore is exported to Japan, South Korea, East European Countries and the Gulf region. Some iron ore is also exported to USA and China. The main ports handling the export are Marmagao, Vishakhapatnam, Paradip, Mangalore, Haldia and Chennai. Japan is the most important buyer of Indian iron ore.

1.3.2. Manganese

Manganese is a black hard iron like metal and is an important raw material for smelting of iron ore and also used for manufacturing ferrous alloys. It is also used for the manufacture of bleaching powder, insecticides, paints, glazed pottery, matches, batteries and china-clay. India has second largest ore reserves in the world after Zimbabwe. Manganese deposits are found in almost all geological formations; however, it is mainly associated with ***Dharwar system***. ***Odisha***

is the leading producer of Manganese. Major mines in Odisha are located in the central part of the iron ore belt of India, particularly in Bonai, Kendujhar, Sundergarh, Gangpur, Koraput, Kalahandi and Bolangir. ***Karnataka*** is another major producer and here the mines are located in Dharwar, Bellary, Belgaum, North Canara, Chikmagalur, Shimoga, Chitradurg and Tumkur. Maharashtra, Madhya Pradesh, Andhra Pradesh, Goa and Jharkhand are minor producers of manganese. India is the world's fifth largest producer of manganese ore as over four-fifth of the total produce of manganese is consumed within the country. Japan is the largest buyer of Indian manganese accounting for about two-third of the total export.

Student Notes:

1.4. Non-Ferrous Minerals

India has limited reserves of non-ferrous minerals except bauxite. Copper, bauxite, gold, silver, tungsten, nickel, cobalt are major non-ferrous minerals.

1.4.1. Copper

Copper has been used for making utensils and coins since long. Also, Copper is an indispensable metal in the electrical industry for making wires, electric motors, transformers and generators. It is alloyable, malleable and ductile. It is a good conductor of electricity and it is used in making electrical wires, equipments and utensils. India has limited reserves of copper. The Copper deposits mainly occur in Singhbhum district in ***Jharkhand***, Balaghat district in ***Madhya Pradesh*** and Jhunjhunu and Alwar districts in ***Rajasthan***. Minor producers of Copper are Agnigundala in Guntur District (Andhra Pradesh), Chitradurg and Hasan districts (Karnataka) and South Arcot district (Tamil Nadu). Mining of copper is a costly and tedious affair as copper ores contain small percentage of metal. The production of copper ore in the country always fall short of our requirements and India has to import copper from other countries, mainly USA, Canada, Zimbabwe, Mexico.

1.4.2. Bauxite

Bauxite is an important ore and is used in making aluminium. Due to its lightness, strength, malleability, ductility, heat and electrical conductivity and resistance to atmospheric corrosion, aluminium has become one of the most useful metals in the present age. It is not specifically a mineral but a rock consisting mainly of hydrated aluminium oxides. Bauxite is found mainly in tertiary deposits and is associated with Laterite rocks occurring extensively either on the plateau or hill ranges of peninsular India and also in the coastal tracts of the country. India is self-sufficient in bauxite reserves. Kalahandi and Sambalpur in ***Odisha*** are the leading producers in the country. Jharkhand, Gujarat, Chhattisgarh, Madhya Pradesh and Maharashtra are other major producers. Bhavanagar, Jamnagar in Gujarat have the major deposits. Chhattisgarh has bauxite deposits in Amarkantak plateau while Katni-Jabalpur area and Balaghat in M.P. have important deposits of bauxite.

1.4.3. Lead

Lead is a widely used material mainly due to its malleability, softness, heaviness and bad conductivity of heat. Important use of lead is as a constituent in alloys such as type metal, bronze and anti-friction metal. It doesn't occur free in nature and occurs as a cubic sulphide known as *Galena*. Lead ores occur in India in the Himalayas, Tamil Nadu, Rajasthan, Andhra Pradesh and Jharkhand. ***Rajasthan*** is the leading producer of lead. Udaipur (Zawar, Rikhabdeo), Dungarpur (Ghughra and Mando) and Alwar are the main producing districts. About 75% of Indian requirements are met by imports mainly from Australia, Canada and Myanmar.

Student Notes:

1.4.4. Zinc

Zinc is a mixed ore containing lead and zinc and is mainly used for alloying and manufacturing galvanized sheets. It is also used for dry batteries, white pigments, electrodes, textiles etc. Known reserves of zinc in India are very limited. More than 99% of zinc in India is produced in Zawar area in Udaipur district of ***Rajasthan***. Most of the industrial needs are met via imports from Zaire, Canada, Australia and Russia.

1.4.5. Gold

Gold is a valuable material which occurs in auriferous lodes and in sands of several rivers. It is known for making ornaments and usage as international currency. India's contribution to global gold production is very small. There are three main gold fields in India namely, Kolar Gold Field, Hutti Gold field in Raichur district of ***Karnataka*** and Ramgiri Gold field in Anantpur district of ***Andhra Pradesh***. Kolar is the largest mine and one of the deepest mines in the world. *Alluvial*

gold is obtained from the sands of the Subarnarekha River in Jharkhand. Such deposits are called placer deposits and the process of recovering gold from these sources is called *panning*.

Student Notes:

1.4.6. Silver

Silver is a precious metal valued next only to gold in making ornaments due to its softness and attractive white colour. It is also used in manufacture of chemicals, electroplating, photography, for colouring glasses etc. The chief ore minerals of silver are agentine, stephanite, pyrargyrite and proustite. India has limited resources of silver ore and majority of production comes from Zawar mines in Udaipur district of ***Rajasthan***.

1.5. Non- Metallic Minerals

Among the non-metallic minerals produced in India, mica is the important one. The other minerals extracted for local consumption are limestone, dolomite and phosphate. They are used in a large variety of industries; the major industries being cement, fertilizers, electrical, etc.

1.5.1. Mica

Mica is mainly used in the electrical and electronic industries as it can be split into very thin sheets which are tough and flexible. It has also been used in India since ancient times as a medicinal item in Ayurveda and is known as ***Abhrak***. Three major types of mica found in India are- Muscovite, Phlogopite and Biotite. Rajasthan have the largest deposits of mica. Mica in India is produced in Hazaribagh plateau of ***Jharkhand***, Nellore district of ***Andhra Pradesh***, Bhilwara and Udaipur in ***Rajasthan*** followed by Tamil Nadu, Karnataka, West Bengal and Madhya Pradesh. India has near monopoly in the production of mica, producing about 60% of the world's total production.

1.5.2. Limestone

Limestone is associated with rocks either composed of calcium carbonate or a mixture of calcium carbonate and magnesium carbonate. It is used for large variety of purposes like cement industry, iron and steel industry, chemical industry etc. Of the total consumption,. 75 per cent is used in cement industry, 16 per cent in iron and steel industry, 4 per cent in chemical industry and the rest in paper, sugar, fertilizers, Ferro-manganese, glass and rubber industries. Limestone is produced in the states of Madhya Pradesh, Rajasthan, Andhra Pradesh, Gujarat, Chhattisgarh and Tamil Nadu. ***Madhya Pradesh*** is the largest producer of limestone in India where large deposits occur in the districts of Jabalpur, Satna, Betul, Rewa.

1.5.3. Dolomite

Limestone with more than 10% of magnesium is called dolomite, when percentage rises to about 45%, it is called true dolomite. Dolomite is chiefly used in metallurgical activities; as refractories; as blast furnace flux; as a source of magnesium salts and in fertilizer and salt industry. Odisha, Chhattisgarh, Andhra Pradesh, Jharkhand, Rajasthan and Karnataka are the major producers of Dolomite in India. Orissa is the largest producer of dolomite in the country with major deposits in Sundargarh, Sambhalpur and Koraput districts.

1.6. Atomic Minerals

Uranium and *thorium* are the main atomic minerals; Beryllium, Lithium and Zirconium are the other minerals. Uranium deposits occur in Singhbhum and Hazaribagh districts of ***Jharkhand***, Gaya district of ***Bihar***, and in the sedimentary rocks in Saharanpur district of Uttar Pradesh. But the largest source of uranium comprise the monazite sands, both beach and alluvial. The largest concentration of monazite sand is on the Kerala coast. Some uranium is found in the copper mines of Udaipur in Rajasthan. India produces about 2% of world's uranium reserves. Thorium is also derived from monazite which contains 10% thorium. Other mineral carrying thorium is thorianite. Kerala, Bihar, Jharkhand, Tamil Nadu and Rajasthan are the main producers.

2. Energy Resources

Student Notes:

Depending upon its source and utilization, energy can be divided into two major classifications viz. (i) Traditional or non-commercial, and (ii) Commercial Energy. Examples of non-commercial energy resources are firewood, charcoal, cow dung and agricultural wastes. The commercial sources of energy comprise coal, oil, natural gas, hydro-electricity, natural gas, nuclear power as well as wind and solar power.

Another important classification based on the nature of energy is conventional energy source and non-conventional energy source. Coal, Petroleum, Natural Gas and electricity are the main sources of conventional energy while solar, wind, tidal, geothermal etc are example of non-conventional source of energy.

2.1. Conventional Energy Sources

The conventional sources are exhaustible resources. Major conventional sources of energy are discussed below:

Student Notes:

2.1.1. Coal

Coal is a one of the important minerals which is mainly used in the generation of thermal power and smelting of iron ore. Coal occurs in rock sequences mainly of two geological ages, namely Gondwana and tertiary deposits. Most of the coal deposits are about 300 million years old.

About 65 per cent of the total coal production is consumed for generating electricity. It is also used as a basic fuel in many industries. Entire process of steel making is based on metallurgical coal. Cement industry consumes about five per cent of the total production. Coal is also an important source of naphtha and ammonia, which are widely used for making chemical fertilizers, tar, benzene, carbon black, etc. Soft coke is used as fuel in the kitchen.

Depending upon the percentage of carbon present, the coal can be *grouped in four types*, such as peat, lignite, bituminous and anthracite.

Peat- It represents the first stage of coal formation, i.e. from wood to coal, today; peat is being formed at many places. It has a high percentage of moisture and volatile matter. The carbon content in peat is less than 40 per cent. It burns like wood and gives more smoke and less heat. It leaves a large amount of ash after burning. Its low heating capacity reduces its value as an industrial fuel.

Lignite- It is generally regarded as the next stage of coal formation after peat. It is also known as the brown coal. Lignite is soft, but more compact than peat. The carbon contents vary from 40 per cent to 60 per cent. Lignite has large percentage of moisture and less amount of combustible matter. The increasing demand for coal has enhanced its use in thermal power stations and in some industries. In India, lignite is mostly found in Rajasthan, Tamil Nadu, Assam and Jammu and Kashmir states.

Bituminous -It is the hard and compact variety of coal. The carbon content varies from about 60 per cent to 80 per cent. Almost 80 per cent of the world's total output of coal is of the bituminous type. The moisture and the volatile contents are also less. Coke is mainly used in the iron and steel industry for smelting iron ore in blast furnaces. Bituminous coal is found in Jharkhand, Orissa, West-Bengal, Madhya Pradesh and Chhattisgarh.

Anthracite - It is the hardest and the best quality of coal. The carbon content varies from about 80 per cent to 90 per cent. Anthracite, practically, has no volatile matter. It does not ignite easily, but once lighted, it has the highest heating capacity. It burns for a long time and leaves very little ash behind. Only about 5 per cent of the world's total coal is anthracite. In India this type of coal is found only in Jammu and Kashmir and that too in very small quantity.

About 80 per cent of the coal deposits in India is of bituminous type and is of non-coking grade. The most important ***Gondwana coal fields*** of India are located in ***Damodar Valley***. They lie in ***Jharkhand-Bengal*** coal belt and the important coal fields in this region are Raniganj, Jharia, Bokaro, Giridih, Karanpura. The other river valleys associated with coal are Godavari, Mahanadi and Son. The most important coal mining centres are Singrauli in Madhya Pradesh (part of Singrauli coal field lies in Uttar Pradesh), Korba in Chhattisgarh, Talcher and Rampur in Odisha, Chanda–Wardha, Kamptee and Bander in Maharashtra and Singareni and Pandur in Andhra Pradesh.

Coal mining industry is facing a lot of problems in India. Some of the ***major problems*** are –

1. The distribution of coal is uneven; this involves high transport cost to carry heavy commodity like coal over long distance. Consequently, the coal consuming industries have to pay much higher prices.
2. Indian coal has high ash content and low calorific value. The ash content varies about 20-30 percent which significantly reduces the calorific value of the product.
3. A large percentage of the coal is taken out from underground mines where the productivity of the labour and machinery is quite low.

4. Besides the problem of pilferage and fire in mines, mining industry is also suffering from problems of environmental pollution.

Student Notes:

2.1.2. Petroleum

Crude petroleum consists of hydrocarbons of liquid and gaseous states varying in chemical composition, colour and specific gravity. It is an essential source of energy for all internal combustion engines in automobiles, railways and aircraft. Its numerous by-products are processed in petrochemical industries such as fertiliser, synthetic rubber, synthetic fibre, medicines, Vaseline, lubricants, wax, soap and cosmetics.

The crude petroleum deposits are found only in the sedimentary rock basins of marine origin. But all sedimentary rocks do not contain mineral oil. Petroleum has an organic origin and is formed by the gradual decay and compression of various marine deposits. They remain buried for millions of years and the decomposition of the organic matter has led to the formation of mineral oil. According to latest estimates the total reserves of crude oil are about 500 crore tons on land and in off-shore regions. There are three main areas of potential petroleum reserves. These are:

1. The Terai zone running parallel to the Himalayas *from* Jammu and Kashmir to Assam;
2. River basins of Ganga, Satluj, etc. including deltaic tracts of Ganga, Mahanadi, Godavari, Krishna and Kaveri;
3. The continental shelf along the Western Coast, Gulf of Cambay, and the islands in the Arabian Sea and the Bay of Bengal. Oil and natural gas have been recently found in exploratory wells in Krishna-Godavari and Kaveri basin on the east coast.

India is not self-sufficient in respect of crude oil and has to import huge quantities from abroad. At present, India has to import about 55 per cent of its needs of petroleum and its products. The imports are mainly from the Middle East countries (Iraq, Iran, Kuwait, Saudi Arabia, Bahrain), Russia, Indonesia, Malaysia and Kazakhstan.

Pipelines are most convenient, efficient and economical mode of transporting liquids like petroleum, petroleum products, natural gas, water, milk etc. India has a pipeline network exceeding 7000 km in the country. **Advantages of Pipeline:** 1. Pipeline 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 low energy consumption. 4. It needs little maintenance. 5. They are safe, accident-free and environmental friendly**. Disadvantages of Pipelines:** 1. They are not flexible i.e. they can be used only for a few fixed points. 2. The capacity cannot be increased once laid down. 3. It is difficult to maintain security arrangements for the pipelines. 4. Underground pipelines cannot be easily repaired and detection of leakage is also difficult.

Student Notes:

Important Pipelines in India:

1. Naharkatia- Nunmati – Barauni Pipeline
2. Mumbai High – Mumbai – Ankaleshwar – Kayoli Pipeline
3. Salaya- Koyali – Mathura Pipeline
4. Hajira – Bijapur – Jagdishpur (HBJ) Gas Pipeline
5. Jamnagar – Loni LPG Pipeline
6. Kandla – Bhatinda Pipeline

2.1.3. Natural Gas

Natural gas is obtained along with oil in all the oil fields. Whenever a well for oil is drilled, it is natural gas which is available before oil is struck. But exclusive reserves have been located along the eastern coast (Tamil Nadu, Odisha and Andhra Pradesh) as well as in Tripura, Rajasthan and off-shore wells in Gujarat and Maharashtra.

With fast expanding transport network, the consumption level is increasing day by day. Oil products constitute nearly 80% of the total commercial energy used in transport. As these energy sources are limited in quantity, so the need of the hour is to develop and implement energy conservation programme in transport sector. The Petroleum Conservation Research Association (PCRA) under the Ministry of Petroleum and Natural Gas has been taking various steps to increase awareness and promote conservation of petroleum products.

Student Notes:

2.2. Non Conventional Energy Sources

With increasing demand for energy and with fast depleting conventional source of energy such as coal, petroleum and natural gas, the non-conventional sources of energy such as energy from sun, wind, bio-mass, tidal , geo-thermal energy are gaining importance. This energy is abundant, pollution-free, renewable and eco-friendly. Besides, it can be supplied evenly to urban, rural and even remote areas. The non-conventional energy sources are cost intensive at the initial stages but will provide more sustained, eco-friendly cheaper energy after the initial cost is taken care of.

2.2.1 Solar Energy

Sun rays tapped in photovoltaic cells can be converted into energy, known as solar energy. The two effective processes considered to be very effective to tap solar energy are ***photovoltaic*** and ***solar thermal technology***. Solar thermal technology has some relative advantages over all other non-renewable energy sources. It is cost competitive, environment friendly and easy to construct. It is generally used more in appliances like heaters, crop dryers, cookers, etc. The western part of India has greater potential for the development of solar energy in Gujarat and Rajasthan.

2.2.2. Wind Energy

Wind energy is absolutely pollution free, inexhaustible source of energy. The mechanism of energy conversion from blowing wind is simple. The kinetic energy of wind, through turbines is converted into electrical energy. The Ministry of non-conventional sources of energy is developing wind energy in India to lessen the burden of oil import bill. The country's potential of wind power generation exceeds 50,000 megawatts, of which one fourth can be easily harnessed. In Rajasthan, Gujarat, Maharashtra and Karnataka, favourable conditions for wind energy exist. Wind power plant at Lamba in Gujarat in Kachchh is the largest in Asia. Another, wind power plant is located at Tuticorin in Tamil Nadu.

2.2.3. Tidal and Wave Energy

Ocean currents are the store-house of infinite energy. For the past few centuries, persistent efforts were made to create a more efficient energy system from the ceaseless tidal waves and ocean current. India has great potential for the development of tidal energy as large tidal waves are known to occur along the west coast of India but so far these have not yet been utilised.

2.2.4. Geothermal Energy

There are vast possibilities of developing and exploiting geothermal energy in India. Lots of hot spring localities have been found in the country. Many potential sites have been identified in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Jharkhand and Chhattisgarh. A geothermal energy plant has been commissioned at Manikaran in Himachal Pradesh.

2.2.5. Bio-energy

Bio-energy refers to energy derived from biological products which includes agricultural residues, municipal, industrial and other wastes. Bio energy is a potential source of energy conversion. It can be converted into electrical energy, heat energy or gas for cooking. It will also process the waste and garbage and produce energy. The technique is based on the decomposition of organic matter in the absence of air to yield gas consisting of methane and

carbon dioxide which can be used as a source of energy. This will improve economic life of rural areas in developing countries, reduce environmental pollution, enhance self-reliance and reduce pressure on fuel wood.

Student Notes:

2.3. Conservation of Natural Resources

In order to promote sustainable development, we need to integrate economic development with environmental concerns. In method of conventional usage of natural resources, there has been large amount of wastage and many environmental problems. Hence, for sustainable development, there is an urgent need to conserve the resources. The alternative energy sources like solar power, wind, wave, geothermal energy are inexhaustible resource and should be developed to replace the exhaustible resources.

3. Manufacturing Industries

Manufacturing is the processing of primary products into more refined and more usable products. Many of the natural products cannot be used directly without processing. It is because of this reason that we manufacture cloth from cotton, sugar from sugarcane, paper from wood pulp etc. By doing so, we make the primary products more valuable and usable. Thus, *manufacturing means transformation of natural material endowments into commodities of utility by processing, assembling and repairing.*

3.1. Types of Industries

Industries are classified in a number of ways.

- On the *basis of* ***size, capital investment and labour force*** employed, industries are classified as large, medium, small scale, and cottage industries.
- On the ***basis of ownership***, industries are categorised as : (i) public sector, (ii) private sector, and (iii) joint and cooperative sector, Public sector enterprises are government/state controlled companies or corporations funded by governments. Industries of strategic and national importance are usually in the public sector.
- Industries are also classified on the ***basis of the use of their products*** such as: (i) basic goods industries, (ii) capital goods industries (iii) intermediate goods industries, and (iv) consumer goods industries.
- Another method of classifying industries is on the ***basis of raw materials*** used by them. Accordingly, these can be: (i) agriculture based industries, (ii) forest-based industries, (iii) mineral-based industries, and (iv) industrially processed raw material based industries.
- Another common classification of industries is ***based on the nature of the manufactured products***. Eight classes of industries, thus identified are: (1) Metallurgical Industries, (2) Mechanical Engineering Industries, (3) Chemical and Allied Industries, (4) Textile Industries, (5) Food Processing Industries, (6) Electricity Generation, (7) Electronics and (8) Communication Industries.

S.N.	Basis	Types of Industries	Chief Characterises	Examples
1	Source of Raw Material	(i)Agro-based industries	(i) Agricultural products used as raw materials (ii) Minerals used as raw materials (iii) Raw materials used from forests (iv) Finished products are used as raw materials for other industries.	(i) Cotton, textile, jute, sugar and paper industry (ii) Iron and steel, chemical and cement industry (iii) Matchsticks and Bidi industries (iv) Motor industries use manufactured iron and steel.
2	Ownership	(i) Public Sector (ii) Private Sector	(i) Operated and controlled by government	(i) Bokaro Steel Plant, Chittaranjan Locomotive

		(iii) Mixed Sector (iv) Cooperative Sector (v) Multinational Companies	(ii) Operated and controlled by an individual or a group as a company; (iii) Established jointly by public and private sector; (iv)Industry established by a co-operative society of raw material producers (v)Foreign companies established their companies with Indian companies	works; (ii) Tata Iron & Steel, Birla Cement; (iii)Maruti Udyog; (iv) Sugar Industry (Maharashtra), Amul (Gujarat); (v)BMW car manufacturer of Germany
3	Major Functions	(i) Basic Industry (ii) Consumer Goods Industry (iii) Capital Goods Industry (iv) Half Manufacturer Industry	(i) Their finished product is used as raw material for other industries (ii) Their finished produce is directly consumed; (iii)Such machines are made which can be used to produce other goods. (iv) Raw materials produced for other industries	(i) Iron & steel Industry (ii) Toothpaste, Soap, Sugar Industries (iii) Produce machines for sugar and cotton mills (iv) Plastic grains industries
4	Knowledge Based Industries	-	Application of special knowledge of manufacturing Hi-tech expertise, engineering and management, Fast growth rate	Software Industry
5	Manufactured Goods	(i) Metallurgical (ii) Mechanical Engineering (iii) Chemical and Related Activities (iv)Textiles (v) Fertiliser (vi) Electronics and Electricals	-	-

Student Notes:

3.2. Location of Industries

Location of industries is influenced by several factors like access to raw materials power, market, capital, transport and labour, etc. Relative significance of these factors varies with time and place. The factors affecting the location of industry can be divided into two broad categories: a) Geographical Factors and b) Non- Geographical Factors.

3.2.1. Geographical Factors

Following are the important geographical factors influencing the location of industries.

Raw Materials: Location of industries is often governed by the location of raw materials. Industries using weight-losing raw materials are located in the regions where raw materials are located. For raw materials which lose weight in process of manufacture or which cannot bear high transport cost or cannot be transported over a long distance because of their perishable nature, industries are often located near the supply of raw materials. Examples of this type of industry are sugar mills, pulp industry, copper smelting and pig iron industries.

Power: Regular supply of power is a pre-requisite for the location of industries. Coal, mineral oil and hydro electricity are the three important conventional sources of power. Most of the industries tend to concentrate around the source of power. Certain industries, like aluminium and synthetic nitrogen manufacturing industries tend to be located near sources of power because they are power intensive and require huge quantum of electricity.

Student Notes:

Labour: Availability of cheap labour is a prerequisite for many industries which are labour intensive in nature. Labour supply should be available in large numbers and also they should have skill or technical expertise as needed. Light consumer goods and agro-based industries need plentiful of labour supplies.

Transport: Transport by land or water is necessary for the assembly of raw material and for the marketing of finished goods. Thus, for proper industrial development, we need to have well developed transport facilities.

Market: The process of manufacturing requires that the finished goods do reach the market. Nearness to market is essential for quick disposal of manufactured goods. It helps in reducing the transport cost and enables the consumers to get products at reasonable prices. Similarly heavy machine, machine tools, heavy chemicals are located near the high demand areas as these are market orientated. Cotton textile industry uses a non-weight-losing raw material and is generally located in large urban centre, e.g. Mumbai, Ahmadabad, Surat, etc. Petroleum refineries are also located near the markets as the transport of crude oil is easier and several products derived from them are used as raw material in other industries.

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 tendency to set up industries in rural areas as cost of land has shot up in urban areas.

3.2.2. Non – Geographical Factors

Apart from the geographical factors, there are various other factors which decide the location of industries in the country. Following are some of the important non-geographical factors which influence the location of industries in the country-

Capital: Modern industries are capital intensive and require huge investments which are generally available in urban centres. Hence, many urban cities have become hub for major industries in the country.

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 an important factor. There is an increasing trend to set up industries in an area where the government policies are favourable and promote industry friendly policies.

Industrial Inertia: Industries tend to develop at the place of their original establishment, though the original cause may have disappeared. This phenomenon is known as geographical inertia or industrial inertia.

Banking Facilities: Establishment of industries involves daily exchange of Crores of rupees which is possible through banking facilities only. So areas with better banking facilities are better suited to the establishment of industries.

3.3. Major Industries

Major industries in India can be studied under the following headings:

3.3.1. Iron & Steel Industry

The development of the iron and steel industry opened the doors to rapid industrial development in India. Almost all sectors of the Indian industry depend heavily on the iron and steel industry for their basic infrastructure. The other raw materials besides iron ore and coking coal, essential for iron and steel industry are limestone, dolomite, manganese and fire clay. All these raw materials are gross (weight losing), therefore, the best location for the iron and steel plants is near the source of raw materials.

Student Notes:

In India, there is a crescent shaped region comprising parts of Chhattisgarh, Northern Odisha, Jharkhand and western West Bengal, which is extremely rich in high grade iron ore, good quality coking coal and other supplementing raw materials. India has 11 integrated steel plants, 150 mini steel plants and a large number of rolling, re-rolling mills and foundries. Except TISCO now Tata Steels Ltd., all the big steel plants are managed by SAIL. The list of integrated iron and steel plants is-

1. Rashtriya Ispat Nigam Ltd. (Vishakhapatnam, Andhra Pradesh)
2. Jindal Steel & Power Ltd. (Raigarh, Chhattisgarh)
3. Bhilai Steel Plant (Bhilai, Chhattisgarh)
4. Boakro Steel Plant (Bokaro, Jharkhand)
5. Tata Steels Ltd. (Jamshedpur, Jharkhand)
6. JSW Steel Ltd. (Bellary, Karnataka)
7. Tata Sponge Iron Limited (Keonjhar, Odisha)
8. Rourkela Steel Plant (Rourkela, Odisha)
9. Salem Steel Plant (Salem, Tamil Nadu)
10. Durgapur Steel Plant (Durgapur, West Bengal)
11. Indian Iron & Steel Company Ltd. (Burnpur, West Bengal)

Details of some of the important iron and steel plant are as follows:

Tata Steel Ltd.: It is the oldest and the largest integrated iron and steel plant in India located at Jamshedpur in Jharkhand. TSL is most ideally located in respect to iron are, coking coal and flux supplies. The plant started producing pig iron in 1908 and steel in 1911. This plant enjoys the following advantages:

(1) **Iron ore** is obtained from the Noamundi mines of Singhbhum district in Jharkhand and the Guruma-hisani mines in Mayurbhanj district of Orissa. (2) Joda mines of Keonjhar(Kendujhar) district of Orissa supply **manganese**. (3) Dolomite, limestone and fire clay are obtained from Sundargarh district of Orissa. (4) Large requirement of **water** for cooling purposes is met from the Subernarekha and Kharkai rivers. (5) **Labour:** Labour is available locally from the Santhal tribe and from Bihar, Uttar Pradesh and Madhya Pradesh. (6) **Coal:** It is available from the mines of Jharia and West Bokaro (Jharkhand).

Student Notes:

Indian Iron and Steel Company (IISCO): The three steel plants at Kulti, Burnpur and Hirapur are located near Asansol in West Bengal. They have merged together to form the Indian Iron and Steel

Company (IISCO). Pig iron is produced at Hirapur plant and sent to Kulti for making steel. The rolling mills are in Burnpur. The IISCO plants have the following geographical advantages: (1) **Iron ore** is brought from Singhbhum (Jharkhand) and Mayurbhanj (Orissa). (2) **Coking coal** is available from Jharia and cheap electricity from the Damodar Valley Corporation. (3) **Manganese** is supplied by Jharkhand, Bihar, Orissa and Madhya Pradesh. (4) **Dolomite** and limestone are obtained from Sundargarh (Orissa) (5) **Cheap labour** is ready available from the adjoining thickly populated states. (6)**Water** is readily available from the Damodar river.

Visvesvaraya Iron and Steel ltd. (VISL): It was established as Mysore Iron and Steel Works in 1923 by the princely state of Mysore. It is located at Bhadravati. This plant is one of the major producers of alloy and special steel in the country.(1) High grade **iron ore** is available from Chikmaglur district; (2) **Manganese** is available from Shimoga and Ghitradurga; (3) it uses **hydroelectric power** from Sharavali project.

Student Notes:

Hindustan Steel Ltd (HSL)-Bhilai: The Bhilai Steel plant is located in the Durg district of Chhattisgarh and was built with the Russian collaboration. Bhilai steel plant has the following geographical advantages; (1) Rich **iron ore** is available from Dalli-Rajhara mines; (2) **Coal** is obtained from Korba and Kargali fields in Madhya Pradesh. (3) **Limestone** from Nandini mines (4) **Manganese** is obtained from Bhandara (Maharashtra) and Ballaghat (Madhya Pradesh) mines (5) **Dolomite** comes from Bilaspur.

3.3.2. Cotton textile Industry

The cotton textile industry is one of the traditional industries of India. The development of this industry in India was due to several factors. One, it is a tropical country and cotton is the most comfortable fabric for a hot and humid climate. Second, large quantity of cotton was grown in India. Abundant skilled labour required for this industry was available in this country.

The first modern cotton mill was established in Mumbai in 1854. By 1947, the number of mills in India went up to 423 but the scenario changed after partition when large number of mills had gone to West Pakistan. The cotton textile industry in India can be broadly divided into two sectors, the organised sector and the decentralised sector. The decentralised sector includes cloth produced in handlooms (including *Khadi*) and power looms.

Cotton is a "pure" raw material which does not lose weight in the manufacturing process. So other factors, like, power to drive the looms, labour, capital or market may determine the

location of the industry. At present the trend is to locate the industry at or close to markets, as it is the market that decides what kind of cloth is to be produced. Also the market for the finished products is extremely variable; therefore, it becomes important to locate the mills close to the market.

In the second half of the nineteenth century, the cotton textile industry expanded very rapidly throughout the country. Thus, the cotton textile industry is located in almost every state in India, where one or more of the locational factors have been favourable. Presently ***Maharashtra***, ***Gujarat*** and ***Tamil Nadu*** are the leading cotton producing states. West Bengal, Uttar Pradesh, Karnataka, and Punjab are the other important cotton textile producers. Tamil Nadu has the largest number of mills and most of them produce yarn rather than cloth.

Although cotton textile is one of the most important industries of India, it suffers from many problems. Some of the ***burning problems*** include- (1) Scarcity of raw materials; (2) Obsolete Machinery; (3) Erratic power supply; (4) Low productivity of labour; (5) Labour strikes; (6) Stiff Competition in domestic and international market; (7) Sick Mills; (8) Lack of finance.

3.3.3. Sugar Industry

The sugar industry is the second most important agro-based industry in the country. India is the largest producer of both sugarcane and cane sugar. The industry provides employment for more than 4 lakh persons directly and a large number of farmers indirectly. Sugar industry is a seasonal industry because of the seasonality of raw materials. As Sugarcane is a weight-losing crop, Sugar factories hence, are located within the cane producing regions.

Maharashtra is the leading sugar producer in the country and produces more than one-third of the total production of the sugar in the country. ***Uttar Pradesh*** is the second largest producer of sugar. The sugar factories are concentrated in two belts – the Ganga-Yamuna doab and the tarai region. In the southern India, sugar mills are located in Tamil Nadu, Karnataka and Andhra Pradesh. The other States which produce sugar are Bihar, Punjab, Haryana, Madhya Pradesh and Gujarat.

Sugar Industry is a *highly localized* industry. The salient features for its localized nature are- (1) Sugar cane is the chief raw material used for making sugar. (2) Sugar cane dries up quickly after harvesting. It can neither be stored nor kept in the field after the crop matures. (3) There should be no gap between harvesting and crushing of sugar cane. (4) Sugar cane is a bulky raw material and only about 9 to 12 tonnes of sugar is produced from 100 tonnes of cane (5) Transportation of sugar cane is costly. To reduce this cost sugar mills are established in sugar cane growing areas. (6) Sugar cane is generally transported through animal *driven* transport or tractor trailers. Therefore most of the sugar mills are installed within 20 km from the cane growing area. (7) Sugar mills have no problem of fuel because the bagasse of sugar cane can be used for heating the juice or for generating electricity. The entire energy requirements of a sugar mill are met through electricity generated with using bagasse as fuel.

3.3.4. Petrochemical Industries

Petrochemical industries are one of the fastest growing industries in India. A variety of products come under this category of industries. Many items are derived from crude petroleum, which provide raw materials for many new industries; these are collectively known as petrochemical industries. This group of industries is divided into four sub-groups: (i) polymers, (ii) synthetic fibres, (iii) elastomers, and (iv) surfactant intermediate. Mumbai is the hub of the petrochemical industries. Cracker units are also located in Auraiya (Uttar Pradesh), Jamnagar, Gandhinagar and Hajira (Gujarat), Nagothane, Ratnagiri (Maharashtra), Haldia (West Bengal) and Vishakhapatnam (Andhra Pradesh).

3.3.5. Machine Tools

It is a core industry and provides mother machines to all sectors of the economy. There are about 200 units manufacturing various types of machine tools and hand tools. The Kirloskar

Student Notes:

Student Notes:

Brothers ltd was the pioneer company, which started production in 1930s. The Hindustan Machine Tools (HMT), Bangalore, a public sector unit, is the first large scale modern machine tools factory in India. These factories produce a large variety of machine tools, such as lathes, radial drilling machines, grinding machines, gear hobbling machines, lamp making machines, etc. Besides machine tools, HMT also produces watches, tractors and printing machinery.

3.3.6. Automobile Industry

Before independence, assembling of foreign made vehicles was done in India. The real development of the industry began with the setting up of two auto mobile units: (I) Premier Automobiles (Mumbai) in 1947, and (ii) Hindustan Motors Ltd. (Kolkata), in 1948. As steel is the basic raw material for this industry, it tends to be located near iron and steel producing; centres. Port cities are preferred due to import and export facilities. The centres producing tyres, tubes, batteries, paints, etc. provide an added advantage. Recently, the trend has been to locate the automobile manufacturing units near the market.

3.3.7. Electronic Industry

The electronics industry has developed mainly after independence. It covers a wide range of products including transistor sets, televisions, telephone exchanges, telecommunication, computers and various equipments for posts and telegraph, defence, railway and meteorological departments. The setting up of the **Indian Telephone Industry (ITI)** in 1950 at Bangalore gave a boost to this industry. The software has emerged as a major industry in the

field of electronics. The computer industry made a modest beginning in the: mid 1970s. Now it has achieved a major breakthrough. The main reason for its rapid growth is a big bank of technically competent manpower. Bangalore is the largest centre of: electronics goods production and is rightly called the **'Electronic Capital** of **India'.**

3.3.8. Knowledge based Industries

The advancement in information technology has significantly increased the knowledge based industries in India. The Information Technology (IT) revolution opened up new possibilities of economic and social transformation. The IT and IT enabled business process outsourcing (ITES BPO) services continue to be on a robust growth path. The IT software and services industry accounts for almost 2 per cent of India's GDP.

3.4. Liberalisation, Privatisation, Globalisation (LPG) and Industrial Development in India

After the new Industrial Policy was announced in 1991, the major objectives of the policy were to build on the gains already made, correct the distortions or weaknesses that have crept in, to maintain a sustained growth in productivity and gainful employment and attain international competitiveness. Within this policy, measures initiated are: (1) abolition of industrial licensing, (2) free entry to foreign technology, (3) foreign investment policy, (4) access to capital market, (5) open trade, (6) abolition of phased manufacturing programme, and (7) liberalised industrial location programme. The industrial licensing system was abolished for all except six industries related to security, strategic or environmental concerns.

The government also decided to offer a part of the shareholdings in the public enterprises to financial institutions, general public and workers. The threshold limits of assets have been scrapped and no industry requires prior approval for investing in the delicensed sector. In the new industrial policy, Foreign Direct Investment (FDI) has been seen as a supplement to the domestic investment for achieving a higher level of economic development. Government has permitted access to automatic route for Foreign Direct Investment under various sectors and respective limits have been setup for various fields. Besides, the industrial policy has been liberalised to attract private investor both domestic and multi-nationals. New sectors like, mining, telecommunications, highway construction and management have been thrown open to private companies. Still there has been a big gap between approved and actual foreign direct investment, even though the numbers of foreign collaborations are increasing. The thrust of globalisation has been to increase the domestic and external competition through extensive application of market mechanism and facilitating dynamic relationship with the foreign investors and suppliers of technology.

On the whole, it has been seen that the major share went to core, priority sectors while infrastructural sector was untouched. Further, the gap between developed and developing states has become wider. Major share of both domestic investment as well as foreign direct investment went to already developed states. In fact, economically weaker states could not compete with the developed states in open market in attracting industrial investment proposals and hence they are likely to suffer from these processes. Thus, we need to look ahead at balancing the act and provide initiatives for the weaker states to reap benefits of the policies of liberalisation, privatisation and globalisation.

3.5. Industrial Regions

Industries are distributed unevenly in India because the factors affecting industrial locations are not the same everywhere. Industries tend to concentrate in few pockets because of certain favourable factors. These pockets of high concentration of industries are known as industrial regions. Several indices are used to identify the clustering of industries, important among them are : (i) the number of industrial units, (ii) number of industrial workers, (iii) quantum of power

used for industrial purposes, (iv) total industrial output, and (v) value added manufacturing, etc. Industrial regions have been classified into three categories: **Major Industrial region** is identified on the basis of a minimum daily factory working force of 1.5 lakh; **Minor industrial region** must have a minimum working force of 25000 labours; **industrial district** has a working labour force of less than 25000.

Student Notes:

Following are the eight major industrial regions of India:

1. Mumbai-Pune Industrial Region*:*

Location and Extent: This region extends along the coast of the Arabian Sea in Maharashtra. It extends up to Pune to the southeast of Mumbai.

Advantages and Factors of Development:

(i) **Raw material:** A lot of cotton is produced in the area around Mumbai. Before independence, however, cotton used to be imported through Mumbai port.
(ii) **Sources of energy:** This region is situated at a long distance from the coal producing regions. But electricity is easily available from the Tata Hydro-electric power houses and the Tarapur Nuclear Power Station.
(iii) **Climate:** Humid climate of this region is suitable for cotton textile industry. Due to humid climate, thread does not snap while spinning.
(iv) **Capital and banking facilities:** Mumbai is a major trading metropolis. Capital and banking facilities are, therefore, easily available.
(v) **Port facilities:** The British purchased the Island of Mumbai in 1774 and built a port here. A railway line had been laid in 1853 connecting Mumbai with Thane. Mumbai port is connected to Pune through Bhorghat Pass and to Nasik through Thalghat Pass. Mumbai port developed rapidly after the opening of the Suez Canal in 1869 .Its hinterland has a dense network of railways and roads. It is a point of convergence of international air routes also.
(vi) **Market:** This region is prosperous economically and the people here have a high purchasing power. Therefore, there is a large demand of industrial goods in the domestic market. The region has easy access to international markets also.
(vii) **Labour:** Skilled and unskilled labour is easily available. Services of foreign experts are also utilised these days.

Important Industries: Cotton textiles, woollen, silk and synthetic fibres and textile printing are the chief industries in this region. It is the largest cotton textile producing region in Asia. Manufacturing vegetable oils, rubber goods, soaps and detergents, electrical goods, engineering goods, automobiles, cycles, etc. and oil refining are also important industries of this region.

Chief Industrial Centres: Mumbai, the neighbouring suburbs of Thane, Lalganj, Parel, Worli, Mahi, Dadar, etc. and Pune are the chief industrial centres of this region.

2. Hugli Industrial Region*:*

Location and Extent: This region extends on both sides of the Hooghly river from Bansberia to the north of Kolkata to Birlanagar to the south.

Advantages and Factors of Development

(i) **Raw material:** Enough raw materials are available locally for jute, paper, chemical, silk, leather and engineering industries,
(ii) **Port facilities:** Kolkata and Haldia ports facilitate import of necessary inputs and export of finished products.
(iii) **Sources of energy:** Coal and electricity are available from Damodar Valley nearby.
(iv) **Water**: Enough water is available from Hooghly and groundwater sources for industries such as jute and paper mills.

Student Notes:

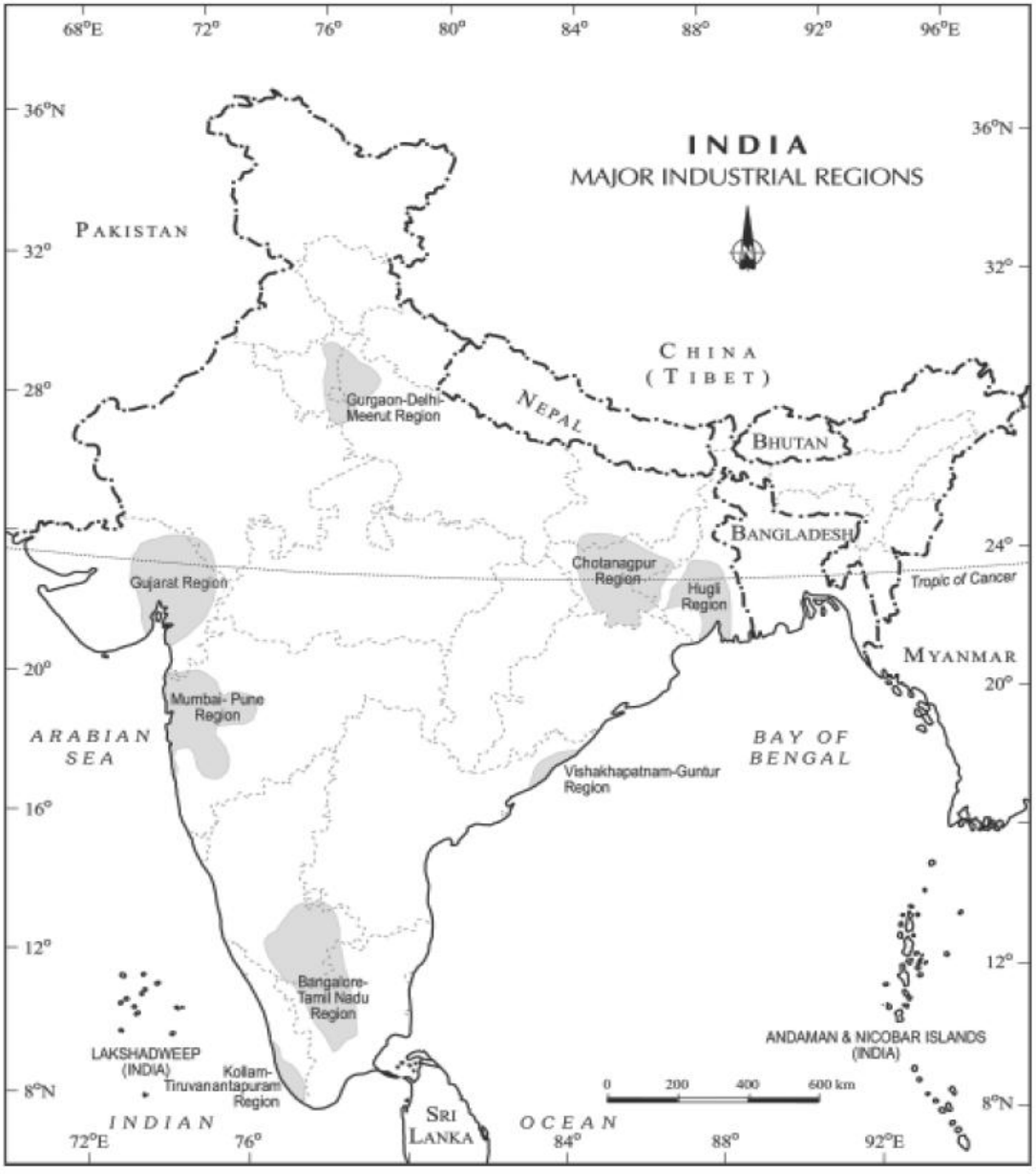
(v) **Capital and banking facilities:** Kolkata being a major trade centre, capital and banking services are easily available.

(vi) **Transport**: Railways and roads link this region with all parts of the country. Rivers Damodar and Hooghly are navigable. Before independence this region was linked with Assam and the other parts of northeast through Brahmaputra waterway.

(vii) **Labour:** This region is surrounded by areas of high density of population. Therefore, there is no shortage of labour. Trained manpower is also available around Kolkata.

Important Industries: Important industries of this region are jute, paper, cotton textiles, automobiles, engineering, electrical goods, chemicals, drugs and pharmaceuticals, diesel engines, machinery for textile and sugar mills, cycles, paints, rubber goods, pottery, silk textiles, vegetable oil and match industries.

Chief Industrial Centres: Haldia, Serampur, Rishra, Howrah, Kolkata, Sibpur, Naihati, Kakinara, Titagarh, Birianagar, Bansberia, etc. are the important industrial centres in this region. Silt deposition in Hooghly poses problems to navigation. Farakka Barrage has been built to regulate the flow in the Ganga to solve this problem. Special ships are used for de silting the Hooghly River. Haldia port on the coast of the Bay of Bengal has been developed to reduce pressure on Kolkata port.



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3. Bangalore-Chennai Industrial Region:

Location and Extent: This region lies in the two states of Karnataka and Tamil Nadu. Madurai is situated in its southern part while Bangalore is situated in the north.

Advantages and Factors of Development

(i) **Raw material:** This region is an important producer of cotton and sugar cane providing raw material for cotton textile and sugar industries. Minerals like iron ore, gold, bauxite, magnetite, etc. are also found here. They serve as raw materials for a number of industries.
(ii) **Climate:** This region has a mild climate which is suitable for hard work round the year.
(iii) **Research institutions:** Research institutions like Central Sugar cane Research Institute, Coimbatore, and Indian Institute of Sciences, Bangalore, situated in this region provide skilled workers and technical support.
(iv) **Transport**: This region has a dense network of railways and roads and connected to Chennai, Mumbai and Mangalore ports
(v) **Sources of energy:** This region does not have coal reserves but hydroelectricity is available. This region has taken advantage of Mettur, Shivasamudram, Papanasam, Pykara and Sharavati hydroelectric power projects.

Important Industries: This region has a variety of industries. Industries like cotton textiles, silk textiles, sugar, leather goods, chemicals, and machine tools have developed here. A number of large public sector industries like Hindustan Machine Tools Ltd.; Indian Telephone Industries, Bharat Electronics and Hindustan Aeronautics are situated in this region. Bhadravati Steel Plant under the management control of SAIL is also situated in this region.

Chief Industrial Centres: Madurai, Sivakasi, Tiruchirapalli, Coimbatore, Madukottai, Mettur, Bangalore, Mysore and Mandya are the important industrial centres. Coimbatore (Tamil Nadu) and Bangalore (Karnataka) have witnessed a rapid industrial development during the last some years.

4. Gujarat Industrial Region:

Location and Extent: This region extends around the Gulf of Khambhat. Gujarat is situated in its northern part and Bharuch in its southern part.

Advantages and Factors of Development

(i) **Raw material:** Area around this region produces large amount of cotton. Mineral oil and natural gas for petrochemical industries are also locally available.
(ii) **Cheap land:** Land is cheap and abundant here in comparison to Mumbai.
(iii) **Labour:** This region has an old tradition of cloth weaving. Therefore, skilled cheap labour for cotton textile industry is easily available.
(iv) **Transport:** Industrial centres of this region are connected with each other and other cities with railways and roads. There are pipelines for transport of gas and oil. [t has given impetus to the development of petrochemical industries.
(v) **Capital:** Ahmadabad and Vadodara are cities of rich people. Therefore capital for industry is easily available.
(vi) **Port Facilities:** This region is served by the new port of Kandla. This port is relatively closer to Europe, Africa and Central Asia.

Important Industries: Cotton textile is the chief industry of this region. Chemical, drugs and pharmaceuticals, woollen and silk textiles, paper, milk products, match and machinery for textile industries are the other important industries. India's famous Amul Milk Industry is in this region. For the past some years, petrochemical industry using mineral oil and natural gas has been making rapid progress.

Student Notes:

Chief Industrial Centres: Ahmadabad, Vadodara, Koyali, Bharuch, Surat, Anand, Kheda, Gandhar, etc. are the chief industrial centres.

5. Chhotanagpur Region:

Location and Extent: This region extends over West Bengal, Bihar and Orissa. The Damodar and the Subernarekha rivers flow through this region.

Advantages and Factors of Development

(i) **Raw material:** This region is rich in mineral resources and has large reserves of iron ore, copper, mica, bauxite, fire clay, coal, manganese, dolomite, limestone, etc.
(ii) **Labour:** Cheap workers from Bihar and Uttar Pradesh are easily available. Trained and skilled workers are also available.
(iii) **Sources of energy:** The well-known coal deposits of Damodar valley lay in this region. Electricity is also available from Damodar valley project.
(iv) **Transport:** This region is connected to the Kolkata port and other parts of India with roads and railways. The canal waterways of Damodar Project are also used.

Important Industries and Chief Industrial Centres: A variety of industries including iron and steel, paper, chemicals, heavy engineering, cycles, aluminium, fertilisers, cement, locomotive and railway wagons, etc. have developed in this region. Iron and steel is the most important industry of Chhotanagpur region. The public sector steel plants of Bokaro, Durgapur, Kulti and Burnpur and the private sector iron and steel plant of Jamshedpur are situated in this very region. Sindri, Chittaranjan, Dhanbad, Ranchi, Chaibasa, Hazaribagh, Daltonganj, Garwa and Japla are the chief industrial centres.

6. Vishakhapatnam-Guntur Region*:*

Location and Extent: This region extends from Vishakhapatnam in Andhra Pradesh to Prakashan and Kurnool districts in the south.

Facilities available and Reasons for Development

(i) **Raw materials:** This area is also agriculturally prosperous. The raw materials like sugar cane, cotton and jute are locally available. Iron ore is available nearby from Bailadila mines and bauxite reserves are also found in the area. Limestone is also available locally,
(ii) **Power resources:** Coal available from Godavari valley and power generated from coal is also available in the region. The benefit of oil and natural gas reserves in Krishna-Godavari basin also accrue to this region.
(iii) **Port facilities:** For import and export trade port facilities are available at Vishakhapatnam and Machilipatnam. It also takes advantage of Chennai and a new port at Ennore.
(iv) **Water:** The surface water of Krishna and Godavari rivers and coastal waters as well as groundwater in coastal areas is adequately available to industries in the region.
(v) **Capital and banking:** Finance and banking facilities are available from Vishakhapatnam, Vijayawada and other cities.
(vi) **Transport:** A network of railways and road transport is found in the area. Many principal railway routes and national highways pass through the region. In this industrial region density of population is also high. There is thus no shortage of labour. There are many higher technical institutions in the cities of Andhra Pradesh. Therefore, trained engineers and workers are also available.
(vii) **Major industries:** In this region chiefly the following industries have developed petrochemicals, sugar, cotton clothes, jute, paper, fertilisers, cement, aluminium, iron and steel, lead, zinc smelting, etc.
(viii) **Chief industrial centres:** The chief industrial centres of the region are Vishakhapatnam, Vijayawada, Vijayanagar, Rajahmundri, Guntur, Eeuru, and Kurnool.

Student Notes:

7. Gurgaon-Delhi-Meerut Region:

Location and Extent: The industrial region is spread over the states of Delhi, Haryana, Uttar Pradesh and Union Territory of Delhi. The region extends from Agra to Ambala.

Facilities Available and Reason for Development

(i) **Raw materials:** This region is away from mining and power resources region. It is, however, agriculturally prosperous region. Sugar cane is the chief crop. It supplies raw materials to a large number of sugar mills in the area. The region is also well developed in milk production.

(ii) **Power resources:** Two main sources are hydel and thermal power. There are many thermal power stations in the region. It gets electricity from Northern Grid of Bhakra-Nangal project.

(iii) **Transport:** There is a vast rail-road network in the region. There are no problems in respect of availability of raw materials, labour, capital and other facilities.

(iv) **Labour:** There is no shortage of trained and skilled labour because of the existence of a large number of educational and training institutions in the area.

(v) **Principal industries:** The industries manufacturing light engineering and consumer durables are found in the area. Chief industries are cotton, woollen and silk mills, instruments and tools, tractors, cycles and car manufacturing units, electronics and vegetable oils, electrical instruments, domestic appliances, agricultural tools, etc. Software and hardware and glass industries are also found. There are also two large oil refineries at Panipat and Mathura in this region.

8. Kollam-Tiruvanantapuram Region*:*

Location and Extent: The region extends from Trichurnagar of Kerala state to Thiruvananthapuram in the South. Five districts of Kerala namely: Trichur, Ernakulam, Allappuzha, Kollam and Thiruvananthapuram districts are located in this region.

Facilities Available and Reasons for Development

(i) **Raw materials:** Almonite, rutoite, zercon, and mononite sands are found in adequate quantities. Plantation, agriculture like tea, coffee, spices, etc supply raw materials to industries.

(ii) **Sources of power:** Hydroelectric power stations found in the region are the main sources of supply of electricity in the region. These power sources are chiefly responsible for industrialisation of the region.

(iii) **Transport:** The principal rail routes and national highway linking coastal regions pass through the area. Even roads are found in hilly regions. This wide network of roads and railways has helped in movement of raw materials and goods. Therefore, distribution of manufactured goods also does not face any problems.

(iv) **Ports:** A chief port in the area namely Kochi has many facilities available.

(v) **Chief industries:** Agricultural products processing related industries such as cotton textiles, sugar, rubber, matches, and fish, mineral-based industries like glass, chemical fertilisers, petroleum and its products, paperboard and coir products, fine instruments, machinery and tools, etc. are found in the area.

(vi) **Principal industrial centres**: The principal industrial centres of the region are Thiruvananthapuram, Kollam, Allappuzha, Kochi, Alwaye and Trichur.

There are **thirteen Minor Industrial Regions** in the country. They are Ambala-Amritsar, Saharanpur-Muzaffarnagar-Bijnor, Indore-Dewas-Uijjain, Jaipur-Ajmer, Kolhapur-South Kannada, Northern Malabar, Middle Malabar, Adilabad-Nizamabad, Allahabad-Varanasi-Mirzapur, Bhojpur-Munger, Durg-Raipur, Bilaspur-Korba, and Brahmaputra valley. Also, there are **fifteen industrial districts** which are Kanpur, Hyderabad, Agra, Nagpur, Gwalior, Bhopal, Lucknow, Jalpaiguri, Cuttack, Gorakhpur, Aligarh, Kota, Purnia, Jabalpur and Bareilly.

Student Notes:

4. UPSC Prelim Previous Year Question

1. Consider the following towns of India: (2014)
1. Bhadrachalam
2. Chanderi
3. Kancheepuram
4. Karnal

Which of the above are famous for the production of traditional sarees/fabric?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1, 2 and 3 only (d) 1, 3 and 4

2. With reference to the management of minor minerals in India, consider the following statements:
1. Sand is a 'minor mineral' according to the prevailing law in the country.
2. State Governments have the power to grant mining leases of minor minerals, but the powers regarding the formation of rules related to the grant of minor minerals lie with the Central Government.
3. State Government have the power to frame rules to prevent illegal mining of minor minerals.

Which of the statements given above is/are correct? (2019)
(a) 1 and 3 only (b) 2 and 3 only
(c) 3 only (d) 1, 2 and 3

5. UPSC Mains Previous Year Question

1. Do you agree that there is a growing trend of opening new sugar mills in southern states of India? Discuss with justification. (2013)
2. Analyze the factors for the highly decentralized cotton textile industry in India. (2013)
3. Whereas the British planters had developed tea gardens all along the Shivaliks and Lesser Himalayas from Assam to Himachal Pradesh, in effect they did not succeed beyond the Darjeeling area. Explain. (2014)
4. Why did the Green Revolution in India virtually by-pass the eastern region despite fertile soil and good availability of water? (2014)
5. Account for the change in the spatial pattern of the Iron and Steel industry in the world. (2014)
6. Mention the advantages of the cultivation of pulses because of which the year 2016 was declared as the International Year of Pulses by the United Nations. (2017)
7. Petroleum refineries are not necessarily located nearer to crude oil producing areas, particularly in many of the developing countries. Explain its implications. (2017)
8. "The growth of cities as I.T. hubs has opened up new avenues of employment, but has also created new problems." Substantiate this statement with examples. (2017)
9. What is the significance of Industrial Corridors in India? Identifying industrial corridors, explain their main characteristics. (2018)
10. Discuss the factors for localization of agro-based food processing industries of North-West India. (2019)

6. Vision IAS Previous Years Mains Questions

1. ***Highlight the reasons behind high concentration of Jute mills in West Bengal. Also give an account of the problems that the jute industry of India is confronted with.***

Approach:

- Briefly mention the status of jute industry in India.
- Mention the reasons for high number of jute mills in west Bengal.
- Discuss the issues pertaining to jute industry in India.

Answer:

Student Notes:

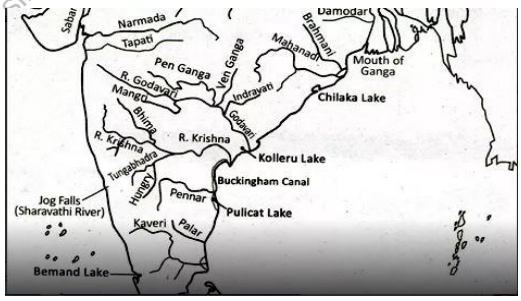
The jute industry is one of the major industries in the eastern region, particularly in West Bengal. The state accounts for over 80 percent of the jute production in the country and employs one-fourth of its population in jute mills.

Reasons for high concentration of jute mills in West Bengal

- **Soil:** The alluvial conditions of Eastern Bengal offer ideal environment for jute cultivation. Thus, availability of raw jute makes jute textile manufacturing the most prominent industry in the state.
- **Transportation:** Inexpensive water transport supported by a good network of railways, roadways and waterways facilitates movement of raw materials, finished products and mill equipments to the mills.
- **Water availability**: The industry requires huge amount of water for processing jute, which is provided by the Hooghly river.
- **Cheap labour:** The jute industry is labour intensive. The labour is abundantly present in the region and adjoining areas of Bihar and Odisha.
- **Energy**: Iron and coal which are required for the installation and running of jute factories are also available from the nearby mines of Raniganj.
- **Geographical Location:** Bangladesh is another major grower of Jute. The jute mills in Bengal get abundant local and imported supply from Bangladesh.
- **Market:** Kolkata as a large urban centre provides banking, insurance and port facilities for export of jute goods.

Despite high potential, the jute industry in India is marred with several issues:

- **Segregation of mills and raw jute:** Prior to partition, Bengal produced half of the world's jute. After partition, raw jute growers in East Bengal (now Bangladesh) and manufacturers in West Bengal found themselves in two countries.
- **Economic Slowdown:** Since 1970s, the slow economic decline of West Bengal led to closure of industrial units and loss of jobs.
- **Lowered demand:** Jute is getting replaced by synthetic fibre. It has lowered the profitability of the industry, leading to low & irregular wages and alleged exploitation of workers.
- **Awareness**: Low awareness among consumers of the versatility and eco-friendly nature of the jute fabric has also been a stumbling block in making it popular.
- **Availability:** Availability of the good quality raw jute is another issue. Mill owners get low quality and cheap jute from neighbouring states and countries.
- **Lack of Technology:** Lack of modernisation and industry's failure to evolve with changing market and consumer demands are other major issues.



To address the above identified issues, the government has come up with several initiatives to revive the sector. The first **National Jute Policy**, **2005** aims to facilitate the sector to attain and sustain a pre-eminent global standing in the manufacture and export of Jute products. Further, **National Jute Board** and **National Jute Mission** were approved to further this aim. India's plan to eliminate single use plastic by 2022 will also give a boost to jute – the golden fibre.

Student Notes:

2. Give a brief account of locational factors that have influenced the distribution of iron and steel industry in India. What are the challenges that this industry faces?

Approach:

- Briefly discuss the status of iron and steel industry in India.
- State the locational factors that have influenced the distribution of the industry in India.
- Mention the challenges faced by the industry.
- Conclude by briefly mentioning measures taken to address the challenges.

Answer:

Development of the iron and steel industry opened the doors to rapid industrial development in India. Almost all sectors of the Indian industry depend on the iron and steel industry for their basic infrastructure.

Locational factors that have influenced the distribution of iron and steel industry in India include:

- **Source of raw materials:** Raw materials used by the industry include iron-ore, coking coal, limestone, dolomite, manganese, and fire clay. They are weight-losing materials. Therefore, iron and steel plants are located near the source of raw materials. For e.g. concentration of iron and steel industries in the crescent-shaped region of parts of **Chhattisgarh, Odisha, Jharkhand and West Bengal**.
- **Transportation:** Major iron and steel plants are located in areas connected by railway lines and ports. For e.g. **TISCO plant** lies very close to the Mumbai-Kolkata railway line and is about 240 km away from Kolkata, which is the nearest port for export of steel.
    - Iron and steel plants have also moved **closer to coastal areas such as Vishakhapatnam, Ratnagiri, Mangalore** due to their dependency on imported ore. Thus, reducing cost of transporting ores from port to factory via railways.
- **Industrial Policy:** India aims at achieving balanced regional development. Establishment of iron and steel industry in **Bhilai and Rourkela** were based on this aim to develop backward areas.
- **Power**: Supply of power is essential to working of machinery. Thus, power supply becomes a determining factor location of any manufacturing industry. For e.g. Damodar Valley Corporation supplies hydel power to the Durgapur Steel Plant and Bokaro Steel Plant.
- **Water:** This industry requires large quantities of water. Therefore, almost all iron and steel industries are located near river or other water sources. Eg- TISCO near Subarnarekha river, IISCO near Barakar river etc.
- **Market accessibility:** Markets provide the outlets for manufactured products. Further, the end product of the industry is heavy and transportation price increases the overall cost if markets are not easily accessible.

Challenges faced by the iron and steel industry include:

- **Dumping:** India has become dumping ground for cheap steel manufactured in China, Japan and South Korea due to falling international prices. As a result, the capacity utilisation rate of domestic steel players is expected to decline.
- **Lack of technology:** Inferior and obsolete technology has resulted in lowered productivity and capacity utilization.
- **Inefficiency of public sector units:** This is due to heavy investment on social overheads, poor labour relations and inefficient management. It hinders functioning of the plants and results in losses leading to rising NPAs.

- **Shortage of metallurgical coal:** Many steel plants have to import metallurgical coal, which increases their cost.
- **Power issues:** High cost of electricity and uncertain power supply slow down the production process.

The government has taken several steps to tackle the issues such as imposition of anti-dumping duty on steel, imposition of import tax, implementation of National Steel Policy, 2017 etc. Also increased focus on infrastructure, housing and manufacturing sector by the current dispensation has spurred the domestic demand of iron and steel. Thus, the Indian Steel Industry is getting competitive as World Steel Dynamics listed 36 Indian steel manufactures as **World Class Steel Makers** in 2017.

Student Notes:

3. What are the major industrial regions of India? In this context, identify the factors that made Mumbai - Pune region as a major industrial hub of the country.

Approach:

- Introduce by mentioning briefly on development of industrial clusters in India.
- Enlist the major industrial regions of India. (Depiction on the map).
- Discuss the reasons for development of major industrial hub in the Mumbai-Pune Region.

Answer:

India is endowed with numerous natural resources, enabling the establishment of various types of industries in different parts of the country. However, there exist regional variations in the levels of industrial development. The industries have concentrated in clusters at some locations due to various reasons like closeness to ports, availability of raw material, skilled labor, markets, etc.

The eight major industrial regions of India are:

- Mumbai-Pune Region
- Hugli Region
- Bengaluru-Tamil Nadu Region
- Gujarat Region
- Chotanagpur Region
- Vishakhapatnam-Guntur Region
- Gurugram-Delhi-Meerut Region, and
- Kollam-Thiruvananthapuram Region.

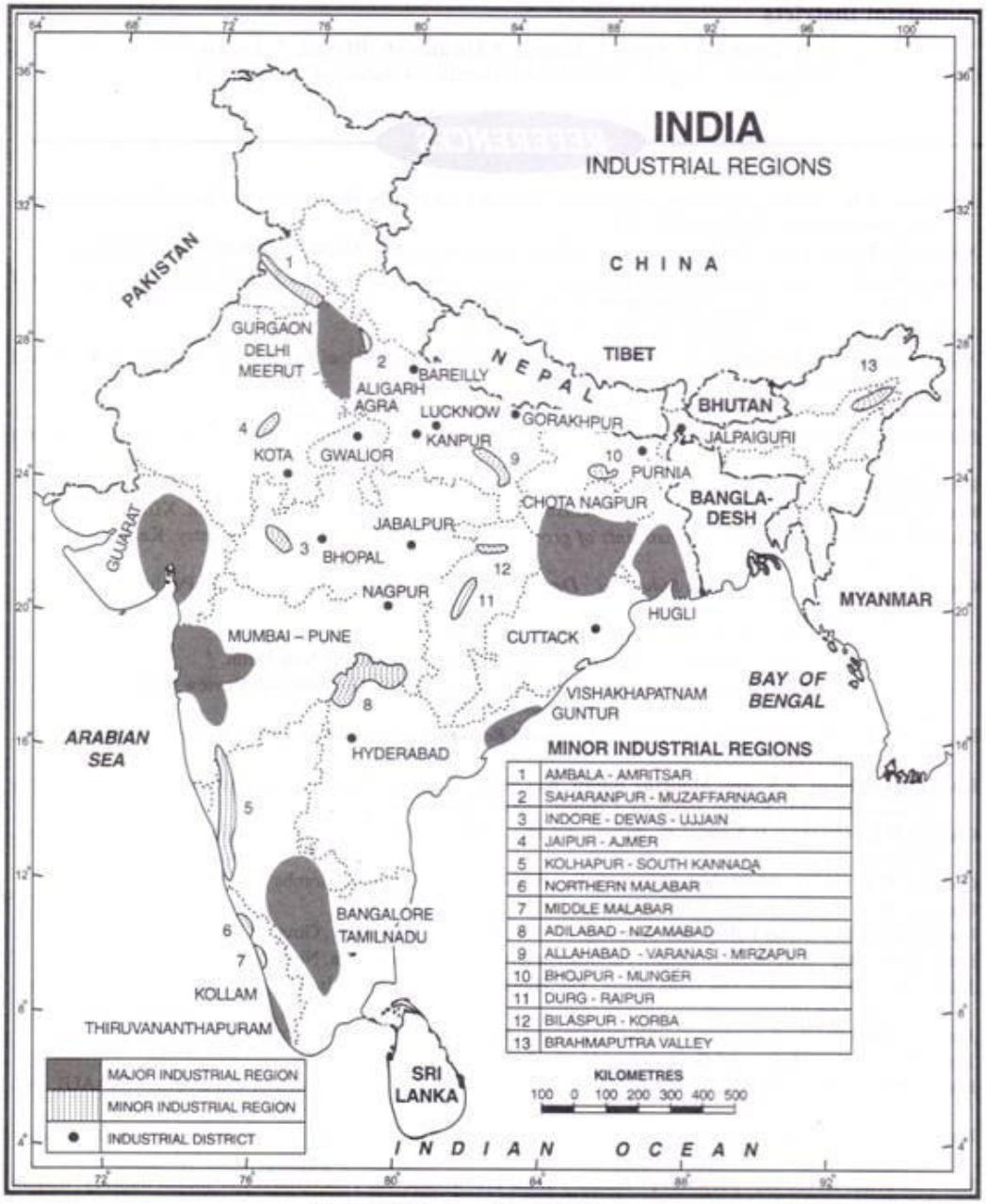


Fig. 27.18. India : Industrial Regions

The **Mumbai-Pune industrial** hub extends from Mumbai-Thane to Pune and in adjoining districts of Nashik and Solapur. It became a major industrial hub with the establishment of first successful modern cotton textile mill at Mumbai in 1854.

The major industries flourishing in this industrial region are **automobiles**, **chemicals**, plastics, cinematography**,** **pharmaceuticals**, machines parts, **engineering goods** petrochemicals, toys, leather goods, electronics, armament, soap, and detergents, etc.

Factors which propelled the growth of industries in the region are:

- **Availability of raw material**- This region is one of the leading producers of cotton (black soil) and sugarcane.
- **Connectivity**- The region is well connected with other parts of the country via rail, road and air services. (Golden Quadrilateral; Mumbai-Pune Expressway). Also, proximity to ports provides opportunities for export and import of goods and services. (Mumbai Port Trust and Jawaharlal Nehru Port Trust)

Student Notes:

- **Energy availability**- The Western Ghats provides immense opportunity for the development of hydel power (Tata hydel power stations at Khopali, Bhivpuri, Bhiraand Koyna). Apart from this, there are atomic power plants at Trombay and Tarapur.
- **Access to capital**- Mumbai being the financial center of the country provides various sources of capital available for the development of industries.
- **Human capital-** The region is home to some of the leading educational and research institutions like IIT Mumbai, Tata Institute of Fundamental Research, the Bhabha Atomic Research Center, the National Institute of Virology, the National AIDS Research Institute. This provides a large skilled labor base which can be deployed in variety of industries.
- **Market availability-** The presence of cities with a large population provides a market for the goods produced by the industries.

Further, the prospects of Fourth Industrial Revolution presents immense opportunities for growth and development in the manufacturing sector. Technological advancement coupled with policy support of the government can help the region build on the present industrial base.

4. Give an account of distribution of sugar industry in India. Also, highlight the problems plaguing the sugar sector.

Approach:

- Introduce with India as leading producer of sugar and sugarcane in the world.
- Draw the distinct sugarcane belts in India.
- Cite factors that determine location of sugar industry around these regions.
- Discuss the hurdles facing the sector and the related environmental challenges.

Answer:

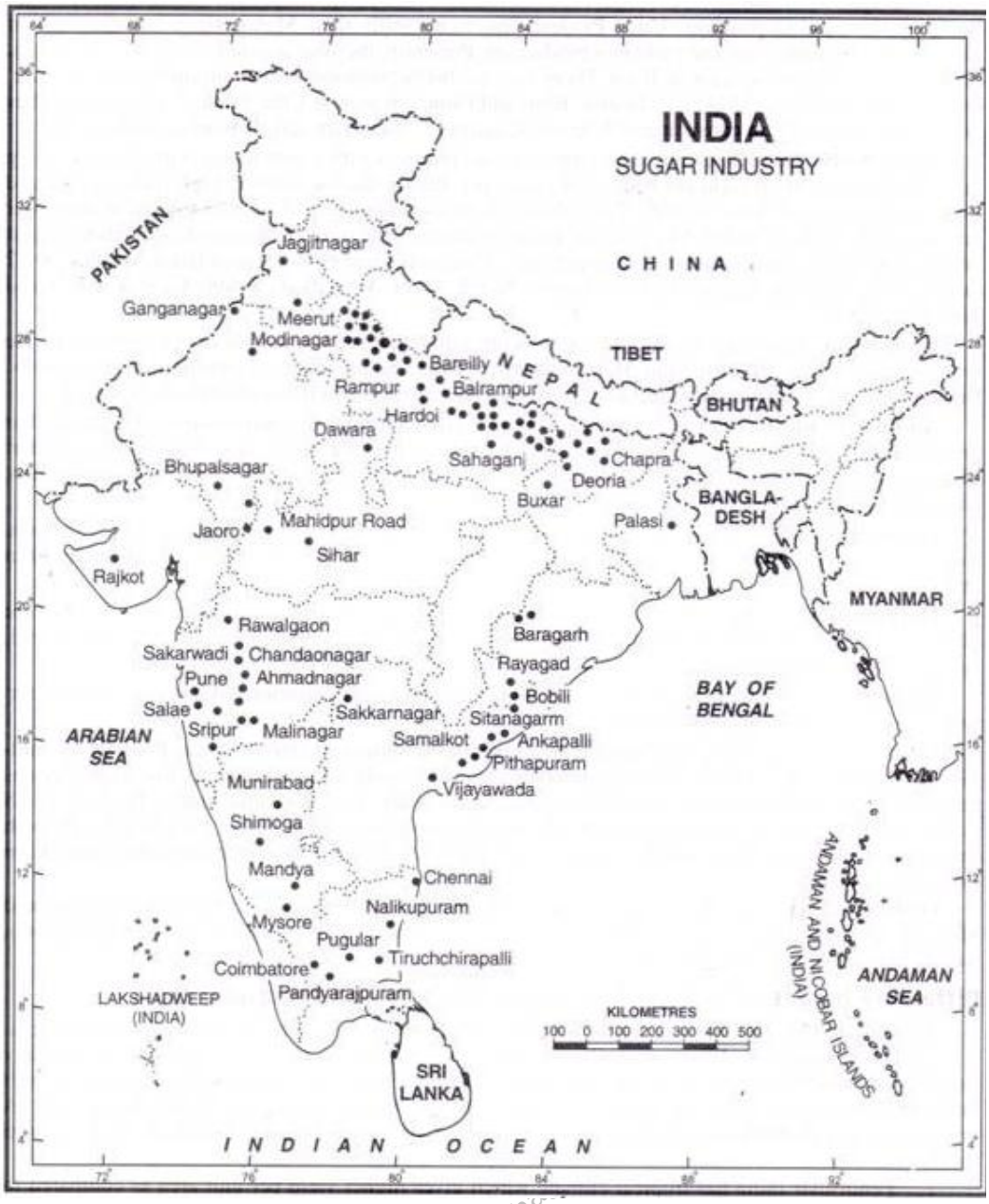
India is the world's largest producer of sugarcane and cane sugar and contributes about 8% of the total sugar production in the world. At present, this is the second largest agro-based industry of India after cotton textile industry.

The sugar industry began in India in the early 20th century by the indigo planters in NE UP and Bihar when the demand for indigo declined due to introduction of the synthetic dye.

Distribution of Sugar Industry Sugar industry in India is based on sugarcane, which are 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. Hence sugar mills are located in the cane producing areas. Also, it is a seasonal industry because of seasonality of raw materials.

Based on these factors, 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.

Student Notes:



Problems facing the sugar industry in India

- **Low yield per hectare** of sugarcane in India in comparison to other countries.
- **Short crushing season** – It makes the industry seasonal creating financial problems for the sector.
- **Fluctuating production trends** – leads to years of severe shortfall, followed by bumper harvest.
- **High cost of production** due to high cost of sugarcane, inefficient obsolete technology, uneconomic process of production and heavy excise duty result in high cost of manufacturing.
- **Small and uneconomic size of mills** with obsolete machinery.
- **Distortion in cropping pattern** – Sugarcane production is water-intensive and is located in water- scare areas like Maharashtra.
- **Competition from khandsari and gur**: In India, 10 tonnes of sugar are obtained from 100 tonnes of cane but in case of khandsari only 7 tonnes of sugar are derived. The recovery content of gur is only 5 per cent. Thus there is a net loss to country by use of cane for khandsari and gur.

Student Notes:

- **Policy issues**- state governments often announce higher Fair and Remunerative Prices (FRP) for the season, often ignoring market dynamics. The mills are required to pay FRP to farmers but are left to market for recovery. In times of bumper production, the market price of sugar almost always becomes uneconomic whereas FRP remains higher. This leads to delay in payments to farmers.

Given the significance of the industry, there is a need to have collaborative approach among, government, farmers and sugarcane mill owners to find solutions for these issues at earliest. The government has announced relief package that would help improve the liquidity of cash-starved sugar industry, including setting aside a sum of Rs 4,440 crore to boost ethanol production capacity and creating a buffer stock of 3 million tonnes of sugar. The CCEA has also decided to fix the minimum selling price of white/refined sugar at Rs 29 per kg and impose stock holding limits on sugar mills. These measures are expected to bring temporary relief to the industry and farmers.

5. Discuss the factors responsible for location of high-tech industries in the vicinity of major metropolitan regions.

Approach:

- Brief introduction about the factors responsible for location of Industries especially hi-tech industries in general.
- Explain why most of the Hi-tech industries are located nearby metropolitan centres.

Answer:

Industrial locations are driven by variety of factors which pull the industry to a particular place. Some of the major factors influencing location include – land, labour, capital, market, power, transport, raw Materials etc.

The hi-tech industries employ advanced technology and are strongly involved in the process of innovation. High technology is the latest generation manufacturing where professionals or white-collar workers do extensive R & D to produce high class product with efficiency.

Reasons why hi-tech industries are located in vicinity of metropolitan regions :

- **Skilled labour**: Though large area is not required for high tech plants, it requires presence of skilled white collar workers who are readily available in metropolis and surrounding regions. Further, Metropolitan people are relatively more educated and they can learn these technologies faster.
- **Market**: Metropolitan areas consist of densely populated urban population which acts as ready market for the hi-tech industry.
- **Infrastructure**: Various amenities such as transportation, power, ICT facilities, availability of office space etc. are available near city locations.
- Leisure facilities: Vicinity regions of metropolitan areas offer excellent leisure facilities like natural parks, golf courses etc.
- **Government support**: in terms of built industrial estates or technology parks on the edge of towns and cities, taxation incentives etc.

In metropolitan areas also, the industries specifically choose peripheral locations as it offers space for future expansion, affordable land rents, proximity to other hi-tech firms and a pleasant working environment with a lot of greenfield sites.

Student Notes:

6. Highlight the factors responsible for location of automobile industries in India. Also, examine the challenges in the wake of transformations taking place in the automotive industry.

Approach:

- Enumerate the locational factors of automobile industry in India.
- Mention the challenges faced by the automotive industry in the wake of turbulent transformations.

Answer:

The state of Auto Industry in a country is an indicator of economic growth in real term because a healthy and growing automobile sector indicates overall industrial economy, good roads, rising income and employment etc. The **location factors for setting up automobile industries in India include**:

- **Proximity to markets**: It guarantees a steady supply of merchandise to clients and lessens the cost of transportation. For eg. Maruti plant in Gurgaon in lieu of the Delhi-NCR market.
- **Supply of raw materials**: For eg. Ahmedabad-Vadodara industrial region has many factories for spare parts, car-accessories, tires, circuit, glasses etc. from which they can easily outsource their parts of the automobile.
- **Transportation facilities**: It guarantees opportune supply of raw materials to the organization and completed products to the clients. For eg. presence of Delhi-Mumbai Industrial corridor (DMIC) enables easy transport of spare parts, raw material and finished cars in the Delhi-NCR and Mumbai manufacturing regions.
- **Infrastructure availability**: The essential framework offices like power, water and waste transfer, and so forth. This is also a reason for many automobile manufacturing hubs such as Chennai auto manufacturing hub to be in and around urban areas.
- **Labour and Wages**: For example, Tata Nano plant in Sanand in Ahmedabad district has a large population and urban amenities, so there's no need to setup special township for workers and their families as there's already a huge availability of labour.
- **Capital**: The capital structure of an area as well as the finance availability with the manufacturer assumes a significant part in getting the consideration of the maker.
- **Government policies**: The arrangements of the state governments and nearby bodies concerning work laws, construction laws, wellbeing, and so on. For eg. Haryana government (Manesar hub) has focused on building local infrastructure, and also gives incentives like tax holidays, and a 10 per cent refund of land cost on timely completion of projects.
- **Supporting/Ancillary industries**: It is important as procurement of segment parts is being increasingly outsourced. For example, Mumbai-Pune-Ahmedabad region has multiple such ancillary industries relating to tyre manufacturing, steel manufacturing, crude oil import etc.

Challenges in view of rapid transformations taking place in the automotive industry:

- The fundamental technological paradigm relies on, **volume production**, it has become progressively more unprofitable in the face of increasingly segmented niche markets.
- **Need to adhere to the quick policy changes,** means that the bulk production has to be vary of any standard requirement **eg. Rapid changes in the Bharat Stage Emission Standards.**

Student Notes:

- **Increasing regulatory and social pressures** to improve both the sustainability of its products and methods of production.
- **Shift towards self-driven cars** and hybrid cars which require companies to spend more on research.
- **Overhauling of purchasing process**: For example, Tesla is selling its vehicles directly to consumers rather than the dealerships, which has been the norm till now.
- **Interpretation of data**: According to Accenture, modern cars collect around 25gb of data per hour from various inbuilt sensors and cameras. This data has the potential for real-time insights to be drawn about performance, speed, condition of components and much more.
- **Slowing down** of pace of growth in unit sales in mature markets and shift in consumer demand and demographics.

India, the second-largest automobiles market with close to 25 million units, has young population; low-cost manpower and dominance in digital technology to its advantage to become a world leader in the future.

7. Giving a brief account of distribution of cotton textile industry in India, identify the factors responsible for localization of this industry in Ahmedabad–Mumbai–Pune region.

Approach:

- Give a brief introduction about the cotton textile industry in India.
- Give an account of distribution of the cotton textile industry in India.
- Discuss the different factors responsible for the localization of this industry in Ahmedabad–Mumbai–Pune region.

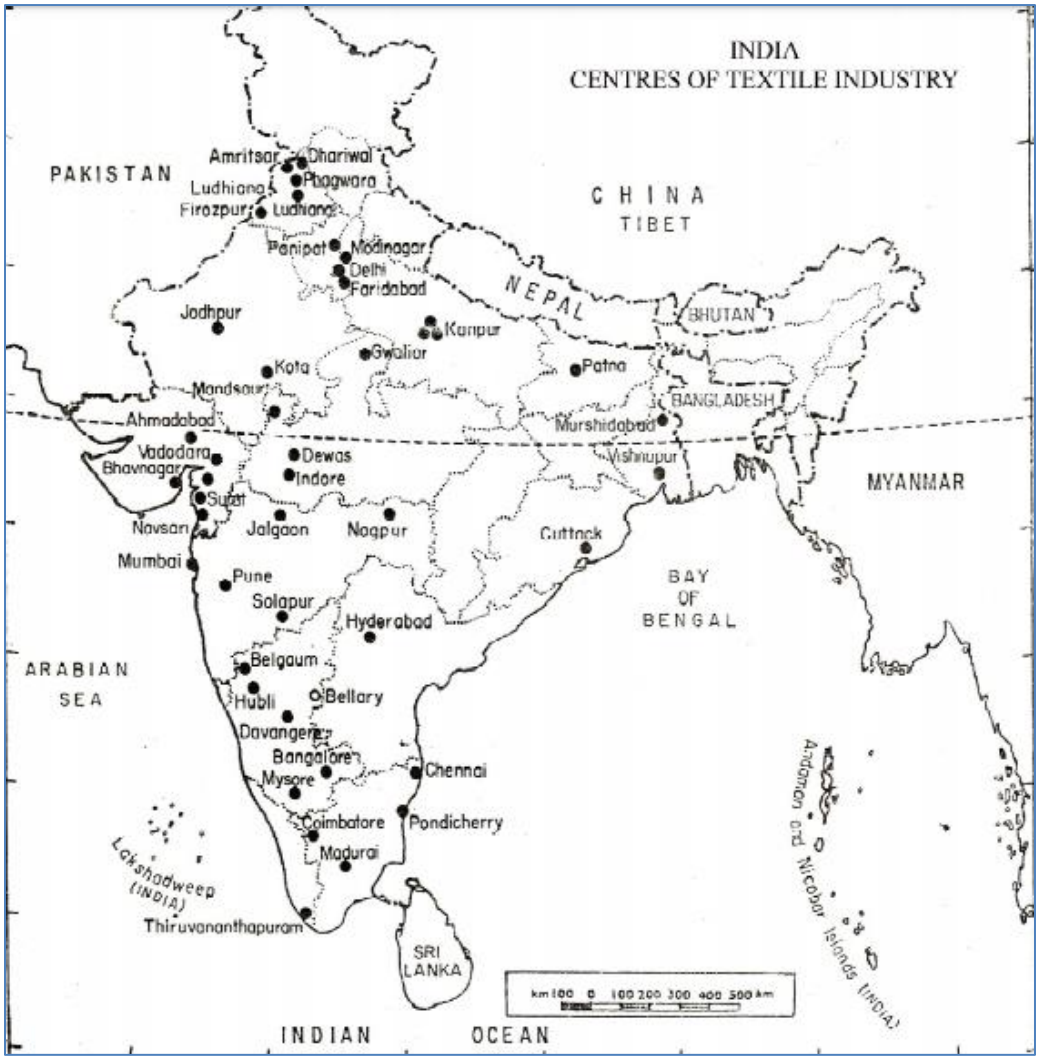
Answer:

Cotton textile industry has an important place in the economy of the country. Cotton textile industry comprises of three sectors: mill sector, handloom and power loom. It is one of the most widely distributed industries in our country and absorbs one-fifth of the total industrial labour of the country. But majority of cotton textile mills are still located in the cotton growing areas of the Great Plains and Peninsular India.

The distribution of cotton textile industry in India is as follows:

- **Maharashtra** is the leading producer of cotton textile in the country. Mumbai is the major centre of textile mills. Sholapur, Kohlapur, Nagpur, Pune, Aurangabad and Jalgaon are the other important centres in Maharashtra.
- **Gujarat** ranks second in the production of cotton textiles. Ahmedabad is the major centre of the state. Surat, Bharauch, Vadodara, Bhavnagar and Rajkot are the other centres in the state.
- **Tamil Nadu** has also emerged as an important producer of cotton textiles in southern states. Coimbatore is an important centre in the state. Tirunelveli, Chennai, Madurai, Tiruchirapalli, Salem and Thanjavour are the other important centers here.
- **In Karnataka**, cotton textile industry is mainly concentrated at Bangalore, Mysore, Belgaum and Gulbarga.
- In **Uttar Pradesh,** Kanpur, Etawah, Modinagar, Varanasi, and Hathras are the important centres.
- In **Madhya Pradesh,** this industry is concentrated at Indore and Gwalior.

Student Notes:



- Howrah, Serampur and Murshidabad are the important cotton textile centres in **West Bengal**.
- Rajasthan, Punjab, Haryana and Andhra Pradesh are the other states producing cotton textiles.

The following are the factors for the localization of the textile industry in **Ahmedabad–Mumbai – Pune** region:

- **Availability of raw material:** A large amount of cotton is grown in this belt due to the availability of black soils (black cotton soil) in some of these regions of Peninsular India.
- **Availability of capital**: Mumbai, Ahmedabad and Pune are the places where capital for investment is easily available.
- **Means of transport**: This region is well connected with the rest of India by roads and railways. It, therefore, facilitates transportation of the finished products.
- **Accessibility to the market**: Maharashtra and Gujarat has a large market to sell textile products here. In present days, due to growth in infrastructure, the market has become a dominant factor in determining the location of cotton textile industry.
- **Nearness to ports**: Mumbai port facilitates the import of machinery and good quality of cotton from abroad and export of the finished products.
- **Cheap labour:** Cheap and skilled labour is easily available from the surrounding areas.

Student Notes:

- **Humid Climate:** These areas have humid climate which is ideal for spinning and weaving. High humidity is good for processing of cotton.
- **Availability of water:** Abundant supplies of soft water are available for dyeing and bleaching.
- **Availability of chemicals:** Chemical industries which supply required chemicals to the cotton textile industries are well developed in Mumbai-Pune industrial belt.
- **Availability of power**: Cheap and sufficient power is easily available here.

With the textile industry contributing around 14% to industrial production and 4 per cent to Gross Domestic Product (GDP), the Ahmedabad–Mumbai–Pune region based cotton textile industry can play a major role in the Indian economy.

8. Assess the changes in distribution pattern of the 'golden fibre' industry in India over the past half century. Also, giving reasons for its decline, enumerate the measures that the government has come up with in order to revive it.

Approach:

- Briefly introduce the golden fibre crop and mention why it is called so.
- Outline the shift in distribution of jute industry over the past half century in India and reasons for the shift.
- Enlist the reasons for decline of the jute industry in the country.
- Mention the initiatives taken by the government to arrest the same.
- Conclude your answer with few suggestions and measures.

Answer:

Golden Fiber

The Jute is popularly known as the ‘golden fiber’ not only because of its golden silky shine but also being a cash crop, it’s industry makes for a profitable economic venture. Next only to cotton, jute is the cheapest and most important of all textile fibres, due to its versatility in usage (geo-textiles to apparel, carpet, decorative items, upholstery, home furnishings) and other features like softness, strength, length, lustre and uniformity.

Distribution pattern of jute industry

After the 1947 Partition, the jute producing areas went to Bangladesh (erstwhile East Pakistan) whereas most of the jute mills remained with India. Starting with the World War-II jute industry has been losing ground to synthetic fibers and over the past half century, jute industry in India has seen many fluctuations. India has lost its position of being largest exporter of raw jute to Bangladesh, while it still remains the largest producer and consumer of jute products in the world.

Currently, jute industry is distributed in states of West-Bengal, Bihar, Assam, Andhra Pradesh, Orissa, Meghalaya, Nagaland, Tripura, and Uttar Pradesh.

Shifts in jute industry

Of late, the jute industry has witnessed following changes in distribution:

- West Bengal has lost its industrial significance and many industries are either lying sick or have closed. Due to overcrowding in traditional belt of Hugli, the industry has been shifting along Ganga river in northern plains. Also, Kolkata is no longer an important international port.
- There has been marked shift towards Godawari delta, as this region has developed paper industry which uses mixture of jute and sabai grass as raw material.
- Demand of Jute from urban areas, apart from traditional uses like sugar, wheat and rice packing bags – this has led to shifting of industry near to the market.

Student Notes:

- Places like east UP and Andhra also meet the natural requirements of Jute industry. Cheap labour is also available.

Decline of Jute Industry

Moreover, Indian jute industry has witnessed decline due to:

A. Supply Side constraints:
1. Shortages of raw material domestically as major producing areas now lie in Bangladesh.
2. Inability of mill owners to upgrade their product according to the trends in the market.
3. Due to strong trade union movement in the traditional jute producing region, the investors shifted their money to other regions and even in other ventures.
4. Instability in Jute prices due to erratic production of the crop
5. High input cost of production due to lack of upgradation of machinery.

B. Demand Side Constraints:
1. Tough competition from synthetic packing materials of the advanced countries of Europe and North America.
2. Emergence of substitutes and wide-scale adoption of containerisation and development of plastics

Measures taken

- Jute Packaging Mandatory Act, 1987 with an objective to protect the Jute industry.
- **National Jute Policy** (2005) for state-of-the-art manufacturing.
- **Jute Technology Mission (JTM)** was launched in 2006 for R&D into all dimensions of the industry.
- **National Jute Board Act 2008** gives statutory backing to National Jute Board for taking measures for all-round development of the industry.
- **Jute Corporation of India** provides support to jute farmers through Minimum Support Price (MSP) operation whenever the raw jute price falls below the MSP.

Way forward

As jute industry is highly labor-intensive and eco-friendly it needs revival in an increasingly environmentally-conscious world.

India should leverage this opportunity by revisiting its raw jute procurement and export policies, renovating and modernizing the production machinery, diversifying the product range, improving the quality and developing new products.

9. With appropriate examples of footloose industry, discuss its significance for India.

Approach:

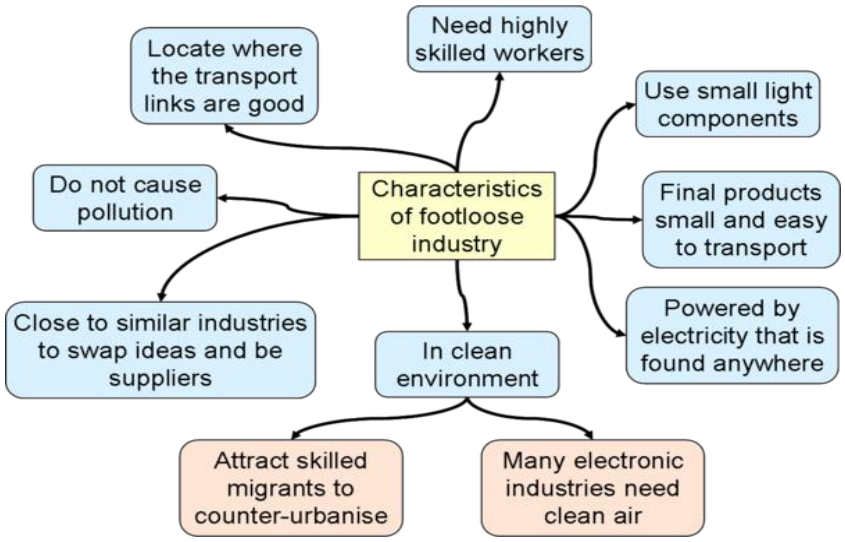
- Explain footloose industry using relevant examples.
- Highlight its significance for India.

Answer:

Footloose industry is a general term for an industry that remains nearly indifferent to locational aspects of business such as material resources, markets or transport. These industries often have spatially fixed costs and are not affected by transportation costs. Thus, a wide range of locations is possible within an area of sufficient population. Some examples of such industries, like bakery, watch-manufacturing, electronics, diamonds etc. use very wide range of light raw materials and thus, the attractive influence of each separate material diminishes. Similarly, IT and ITeS can be established anywhere where the physical infrastructure and workforce is available.

Student Notes:

Characteristics of footloose industry:



Significance for India:

- **Solution to regional disparities:** Such industries can be bridge regional disparity as their development can be influenced by appropriate policy and governance measures like tax rebates, physical infrastructure development, land acquisition and law and order situation. Southern states have used such policy measures to develop IT industry while northern and eastern states are yet to leverage the same.
- **Employment generation potential:** Heavy industries are capital intensive but footloose industry is generally labour intensive. Thus, it has immense potential to create employment. With decentralisation, textile has practically become a footloose industry, with huge labour absorption capacity.
- **Boost to development of skilled populace:** Footloose industry needs skilled workers to serve on quality and productive jobs. Thus, it incentivises the development of colleges, training institutes, apprenticeship courses etc. in a given region e.g. proposed Indian Institute of Skills in Kanpur.
- **Boost to growth of allied/ related sectors:** It boosts overall economy of the region by growth of related sectors like hospitality, real estate, recreational activities etc. For example, establishment of IT offices has boosted development of nearby areas in Maharashtra.
- **Development of agglomerations:** Suburban land is often cheaper. Out of town surroundings and easy access to workers in suburbs provides ideal location for building business parks. It also helps in decongestion of cities.
- **Exports potential:** Such industries have huge potential for exports, for example, the diamond and other industries in Gujarat have led to its emergence as one of the largest exporting States in India
- **Environment-friendly:** Since, such units are relatively less polluting, lesser environmental costs are associated with these

Thus, it is important that the Centre and the States pay attention to this sector. States must improve ease of doing business. Centre must support through skill development, credit schemes etc. specific to various footloose industries. A coherent effort can only help realise the true potential of this sector.

Student Notes:

10. The location of fertilizer plants is closely related with location of oil refineries and coal producing areas. Elaborate. Also, account for the setting up of fertilizer plants nearer to consumer centres such as in Uttar Pradesh.

Approach:

- Elaborate upon how location of fertiliser plants is closely related with location of oil refineries and coal producing areas.
- Discuss the factors responsible for setting up fertiliser plants nearer to consumer centres.

Answer:

Currently, India is one of the largest producer and consumer of fertilizers in the world. The health and growth of the fertilizer industry is vital for boosting agricultural productivity, ensuring food security, generating employment opportunities and ensuring regional development.

The fertilizer industry mainly grew in the post independence era and got concentrated in Gujarat, Uttar Pradesh, Punjab, Tamil Nadu and Maharashtra.

The location of fertilizer industry is closely related to oil refineries and coal producing areas because:

- Naphtha obtained during refining of oil is used as a basic raw material for production of Nitrogenous fertilizers.
- Methane obtained from coal seams and during coal production is used for manufacturing ammonia, which is then used for making nitrogen based fertilizers like Urea.
- Fertiliser industry requires constant supply of energy. Thus, its location near to oil and coal resources fulfils that requirement.
- Coal producing areas are also associated with production of other rock minerals which are needed in fertiliser production process.

However, quite recently the fertilizer plants are increasingly located near to the consumer centers due to the following reasons:

- Due to intensive cultivation in the Indo-Gangetic plains, rate of Fertiliser consumption has increased especially in the Green Revolution belt comprising of Punjab and Northern Uttar Pradesh region. This has necessitated the dispersion of industry towards consumer centres such as Gorakhpur, Panipat etc.
- Ease of transport through Hazira-Vijaipur-Jagdhishpur(HVJ) gas pipeline and rail has facilitated diversification of this industry at Vijaypur, Jagdalpur, Aonla, Gadipan, Babrala and Shahjahanpur.
- Further, due to increased incidents of soil degradation, the demand for fertilizers has intensified in the core agricultural belts. This has further fuelled the localization of fertilizer plants.
- Fertiliser subsidy by government has also incentivised decentralised fertiliser production near the consumer centres.

Thus, fertilizer industry is no more bound to the hitherto raw material rich regions. New set of demand and supply side factors coupled with government policies have started playing crucial role in determining its final location.

Student Notes:

TRANSPORT & COMMUNICATION AND INTERNATIONAL TRADE

Contents

Student Notes:

1. Transport

Transport provides services of carrying men and materials from one place to another. It links all the spheres of earth, land, air and water. Development of cheap and efficient means of transport is necessary for the progress of a country. Transport routes serve as basic economic arteries of the country and provide important link between production and consumption. Density of transport network and its modernity is the index of economic development of any country.

Transport system can be broadly classified into *four distinct ways* i.e. land transport, water transport, air transport and pipeline transport. Land transport can be taken by man himself or through animal transport, road transport or rail transport. Water transport can be classified in inland transport systems and oceanic waterway transport systems.

1.1. Land Transport

Man has been using footpaths for transport since prehistorical times. After the invention of wheel, when manmade carts, driven by oxen, horse and camel and made use of unsurfaced roads; with the invention of steam engine need was felt for providing rail lines. First such rail line was, perhaps, from Stockton and Darlington in northern England opened in 1825. Soon the first public railway system became very popular as it was *very* convenient and fastest mode of transport. The networks of road and rail transport threw open remote interior parts of continents to human settlements, grain farming and industrialisation.

1.1.1. Road Transport

Pt. Jawaharlal Nehru said, *"The path of development goes to villages through roads"*. This is true to other fields too. The roads are harbingers of economic development. Only 20 per cent population of the world lives in developed countries, but it has 72 per cent cars, buses, trucks, etc. of the world. Road networks are found in high density in areas with higher population density round the world. With the advancement in technology, metalled roads are reaching the countryside and helping in connecting people.

1.1.1.1. Advantages of Roads

The major advantages of road transport over other means of transport are as follows: -

1) Road transport is cheaper than rail transport. Its cost of construction, repair and maintenance is comparatively less than railway transport.
2) Roads are available up to the house of consumer. The producer and trader prefer roads only because there arise no need of loading and unloading of their goods at different places. The raw material and the machines reach the factory directly and the products to the consumers safely.
3) Road transport is the best for short and medium distances. People and goods take less time in reaching their destination.
4) Roads are highly useful for transporting ephemeral goods such as green vegetables, fruits and milk. The roads are basis of truck farming.
5) Anytime, anywhere no problem of time and travel.
6) Regular expenditure on roads is *very* low as compared to rail transport which is high on maintenance of stations, platforms, rail-routes and on employing large number of employees for running the railways.
7) The construction and usage of roads in inaccessible hilly areas with steep slopes and forested areas is difficult but possible.
8) Packing of goods is not always necessary in road transport. Sometimes, fruits and vegetables are loaded without packing.
9) Roads can negotiate steep slopes and sharp turns and are more flexible means of transport.

Student Notes:

1.1.1.2. Distribution of Roads in the World

The road network is not evenly spread throughout the world; the density of roads is not the same everywhere nor is there any system of distribution of roads between small towns and cities. City roads suffer from chronic traffic congestion. There are peaks (high points) and troughs (low points) of traffic flow between certain hours of the day. It is estimated that total length of roads in the world is three crore nine lakh km. Out of this only 1.5 crore km roads can be used in all seasons. The North American continent alone has 35 per cent of world's good roads. The economically and industrially advanced countries have generally a good road network whereas developing and poor countries cannot cope with the demands of traffic. The United States of America has also highest road density.

Having consideration for safety on roads, many theories of transportation or traffic-flows have been put forward. These seek to describe in a precise mathematical way the interactions among vehicles, drivers, and the infrastructure. It has been found that there is some kind of relationship between these elements which if studied properly could help in planning, design, and operations of roadway facilities. Particular attention is paid in respect of *flow, density and velocity.* In most cities of the world there is chronic traffic congestion. Many suggestions have been made for urban transport solutions. Among these suggestions include:

(i) Higher Parking Fee
(ii) Mass Rapid Transit (MRT)
(iii) Improved Public Bus Service
(iv) Expressways / Toll Roads

1.1.1.3. Distribution of Roads in India

India has one of the largest road networks in the world with a total length of 46.9 lakh km (2013). About 65% of freight and 80% passenger traffic is carried by the roads. National Highways in India constitute only about 1.7% of the road network but carry about 40% of the total road traffic. Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years.

India has a long tradition of building roads since the times of Chandragupta Maurya and Asoka. The real progress was made during Mughal period, when Sher Shah Suri constructed a road between Peshawar and Kolkata. It is now called *Grand Trunk (G.T.) Road.* Road transport in modern sense was very limited in India before World War-II. The first serious attempt was made in 1943 when '*Nagpur Plan'* was drawn. This plan could not be implemented due to lack of coordination among the princely states and British India. After Independence, twenty-year road plan (1961) was introduced to improve the conditions of roads in India. However, roads continue to concentrate in and around urban centres. Rural and remote areas had the least connectivity by road. Currently, the Indian road network consists of National Highways, State Highways, District roads and Village roads. Besides these, there are International highways and the Expressways, which are of recent development.

1.1.1.3.1. National Highways

These are the main roads, which are constructed and maintained by the Central Government through *National Highway Authority of India (NHAI)*[1], which was established in 1995. These roads are meant for interstate movement and connect the state capitals, important ports, major cities and railway junctions. The total length of the National Highways was about 19,700

[1] The National Highways Authority of India (NHAI) was formed in 1995. It is an autonomous body under the Ministry of Surface Transport. It is entrusted with the responsibility of development, maintenance and operation of National Highways. This is also the apex body to improve the quality of the roads designated as National Highways.

km in 1951. It has increased to about 70,934 km in 2012. The National Highways are only 2 per cent of the total road length in India, but these roads carry about 40 per cent of the total road traffic of India.

As of now about 26 per cent (18,350 km) of the total length of National Highways (NHs) is single lane/intermediate lane, about 51 per cent (36,031 km)is two-lane standard, and the balance 23 per cent (16,553 km)is four-lane standard or more.

The NHDP project is composed of the following phases:

Phase I: The Golden Quadrilateral (GQ) connecting the four major cities of Delhi, Mumbai, Chennai and Kolkata. This project connecting four metro cities would be 5,846 km (3,633 mi). Total cost of the project is Rs.300 billion (US$6.8 billion), funded largely by the government's special petroleum product tax revenues and government borrowing. In January 2012, India announced the four lane GQ highway network as complete.

Phase II: North-South and East-West corridors comprising national highways connecting four extreme points of the country. The North-South and East-West Corridor (*NS-EW*; 7,300 km) connecting Srinagar in the north to Kanyakumari in the south, including spur from Salem to Kanyakumari (Via Coimbatore and Kochi) and Silchar in the east to Porbandar in the west. Total length of the network is 7,300 km (4,500 mi). The Golden Quadrilateral and the corridors will also be connected to 10 major ports of India, namely Kandla, Jawaharlal Nehru Port, Marmagao, New Mangalore, Kochi, Tuticorin, Ennore, Vishakhapatnam, Paradip and Haldia, through a road length of 363 km.

Phase III: The government recently approved NHDP-III to upgrade 12,109 km (7,524 mi) of national highways on a Build, Operate and Transfer (BOT) basis, which takes into account high-density traffic, connectivity of state capitals via NHDP Phase I and II, and connectivity to centres of economic importance.

Phase IV: The government is considering widening 20,000 km (12,000 mi) of highway that were not part of Phase I, II, or III. Phase IV will convert existing single lane highways into two lanes with paved shoulders. The plan will soon be presented to the government for approval.

Phase V: As road traffic increases over time, a number of four lane highways will need to be upgraded/ expanded to six lanes. The current plan calls for upgrade of about 5,000 km (3,100 mi) of four-lane roads, although the government has not yet identified the stretches.

Phase VI: The government is working on constructing ***expressways*** that would connect major commercial and industrial townships. It has already identified 400 km (250 mi) of Vadodara (earlier Baroda)-Mumbai section that would connect to the existing Vadodara (earlier Baroda)-Ahmadabad section. The World Bank is studying this project. The project will be funded on BOT basis. The 334 km (208 mi) Expressway between Chennai—Bangalore and 277 km (172 mi) Expressway between Kolkata—Dhanbad has been identified and feasibility study and DPR contract has been awarded by NHAI.

Phase VII: This phase calls for improvements to city road networks by adding ring roads to enable easier connectivity with national highways to important cities. In addition, improvements will be made to stretches of national highways that require additional flyovers and bypasses given population and housing growth along the highways and increasing traffic. The government has not yet identified a firm investment plan for this phase.

1.1.1.3.2. The State Highways

These highways are constructed and maintained by the State Governments through their respective Public Works Departments (PWD). The State Highways provide linkages with the National Highways, district headquarters, important towns, tourist centres and minor ports and carry the traffic along major centres within the state. These arterial routes provide connectivity to important towns and cities within the state with National Highways or State Highways of the

Student Notes:

neighbouring states. Their total length is about 137,712 km. These constitute 4 per cent of total road length in the country.

Student Notes:

1.1.1.3.3. The District Roads

These roads are constructed and maintained by Zila Parishads and the Public Works Departments. The district roads mostly connect the district headquarters with the main towns and large villages within the districts. Now most of these roads are metalled roads and provide accessibility to the rural areas. The total length is about 4,70,000 km. They account for 14 per cent of the total road length of the country.

1.1.1.3.4. The Village Roads

These roads are constructed and maintained by the Village Panchayat. They connect the villages with the neighbouring towns and cities. These roads made great progress under the Pradhan Mantri Grameen Sadak Yojana (PMGSY). Under this scheme, the all weather roads are constructed to provide easy access to the villages. Their total length in 2005 was 26,50,000 km, which was about 80 per cent of all types of roads in India.

1.1.1.3.5. The Border Roads

The Border Roads Organisation (BRO) was established in 1960. Its main aim was to plan and construct roads of strategic importance in the northern and north-eastern border areas of the country. BRO has constructed roads in high altitude mountainous areas. Apart from this main work, the BRO also undertakes snow clearance in high altitude areas.

1.1.1.3.6. Expressways

Expressways are the highest class of roads in the Indian Road Network. An expressway is a controlled-access highway; it is a highway that controls entrances to it and exits from it by incorporating the design of the slip roads for entry and exit into the design of the highway itself. Expressways make up approximately 1,208 km (751 mi) of India's road network, as of 2013. The expressways in use are:

Student Notes:

NATIONAL HIGHWAYS DEVELOPMENT PROJECT PHASE - I, II & III

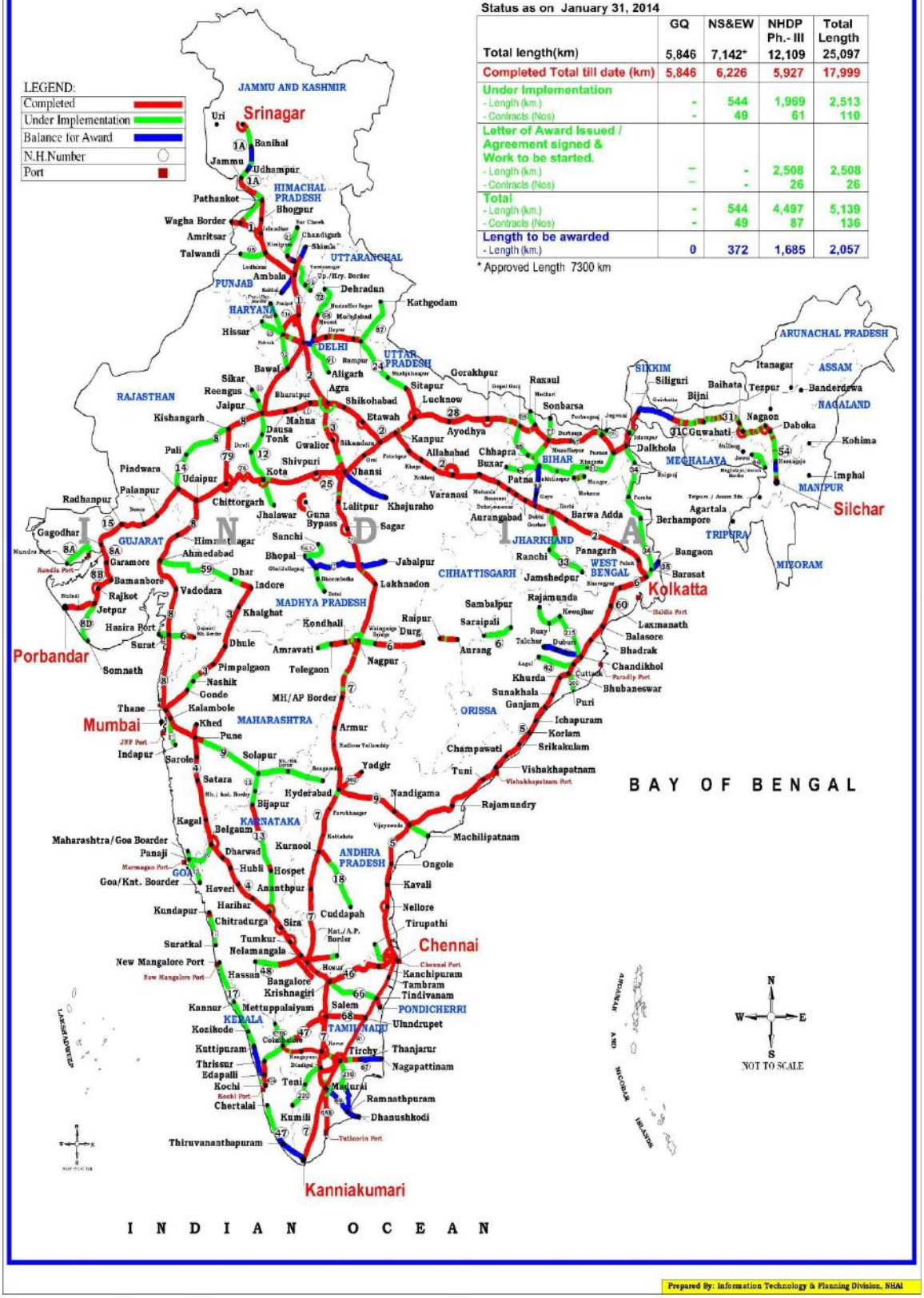
Status as on January 31, 2014

NADP

Status as on January 31, 2014

	GQ	NS&EW	NHDP Ph.- III	Total Length
Total length(km)	5,846	7,142*	12,109	25,097
Completed Total till date (km)	5,846	6,226	5,927	17,999
Under Implementation				
- Length (km.)	-	544	1,969	2,513
- Contracts (Nos)	-	49	61	110
Letter of Award Issued / Agreement signed & Work to be started.				
- Length (km.)	-	-	2,508	2,508
- Contracts (Nos)	-	-	26	26
Total				
- Length (km.)	-	544	4,497	5,139
- Contracts (Nos)	-	49	87	136
Length to be awarded				
- Length (km.)	0	372	1,685	2,057

* Approved Length 7300 km



Prepared By: Information Technology & Planning Division, NHAI

National Highway	Route	Distance
NH-1	Jalandhar – Uri	663
NH-1A	New Delhi-Ambala-Jalandhar-Amritsar	456
NH-2	Delhi-Mathura-Agra-Kanpur-Allahabad-Varanasi-Kolkata	1465
NH-3	Agra-Gwalior-Nasik-Mumbai	1161
NH-4	Thane and Chennai via Pune and Belgaum	1235
NH-5	Kolkata - Chennai	1533
NH-6	Kolkata – Dhule	1949
NH-7	Varanasi – Kanyakumari	2369
NH-8	Delhi-Mumbai-(via Jaipur, Baroda and Ahmedabad)	1428
NH-9	Mumbai-Vijayawada	841
NH-10	Delhi-Fazilka	403
NH-11	Agra- Bikaner	582
NH-12	Jabalpur-Jaipur	890
NH-13	Sholapur-Mangalore	691
NH-15	Pathankot-Samakhiali	1526
NH-17	Panvel-Edapally	1269
NH-22	Ambala-Shipkitr	459
NH-28	Lucknow-Barauni	570

List of Main National Highways in India

1) Greater Noida – Agra Yamuna Expressway (165 kilometres)
2) Ahmadabad Vadodara Expressway (95 kilometres)
3) Mumbai-Pune Expressway (93 kilometres)
4) Jaipur-Kishangarh Expressway (90 kilometres)
5) Allahabad Bypass Expressway (86 kilometres)
6) Durgapur Expressway (65 kilometres)
7) Ambala Chandigarh Expressway (35 kilometres)
8) Chennai Bypass Expressway (32 kilometres)
9) Delhi-Gurgaon Expressway (28 kilometres)
10) NOIDA-Greater NOIDA Expressway (24 kilometres)
11) Delhi-NOIDA Flyway (23 kilometres)
12) Mumbai Nasik Expressway (150 kilometres)
13) PVNR Hyderabad Airport Expressway (12 kilometres)
14) Hyderabad ORR Expressway (150 kilometres)
15) Guntur-Vijayawada Outer ring road Expressway (46 Kilometres) Outer Ring Road, Guntur & Vijayawada
16) Coimbatore Bypass expressway (28 kilometres)

1.1.1.3.7. The Asian Highway (AH)

The Asian Highway (AH) project, also known as the Great Asian Highway, is a cooperative

project among countries in Asia and Europe and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), to improve the highway systems in Asia. It is one of the three pillars of the Asian Land Transport Infrastructure Development (ALTID) project, endorsed by the ESCAP commission at its 48th session in 1992, comprising Asian Highway, Trans-Asian Railway (TAR) and facilitation of land transport projects. Agreements have been signed by 32 countries to allow the highway to cross the continent and also reach to Europe. Some of the countries taking part in the highway project are India, Sri Lanka, Pakistan, China, Japan, South Korea and Bangladesh. Most of the funding comes from the larger, more advanced Asian nations like Japan, India and China as well as international agencies such as the Asian Development Bank.

Student Notes:

The following are the routes which pass through India –

1) AH1; Petrapole to Atari via NH 1 & 2
2) AH42, 3,754 km (2346 miles); Lanzhou, China (on AH5) to Barhi, India (on AH1)
3) AH43, 3,024 km (1892 miles); Agra, India (on AH1) to Matara, Sri Lanka
4) AH44, 107 km (67 miles); Dambulla, Sri Lanka (on AH43) to Trincomalee, Sri Lanka
5) AH45, 2,030 km (1269 miles); Kolkata, India (on AH1) to Bangalore, India (on AH43/AH47)
6) AH46, 1,967 km (1,222 miles); named Great Eastern Highway within India from its East Coast to West Coast - Hazirah-Surat-Jalgaon-Howrah(Kolkata) till AH2.
7) AH47, 2,057 km (1286 miles); Gwalior, India (on AH43) to Bangalore, India (on AH43/AH45)
8) AH48, 1 km (.625 miles); Phuentsholing, Bhutan to border between Bhutan and India

1.1.1.4. Road Density

The distribution of roads in India is highly uneven. The density of roads (length of roads per 100 sq km of area) varies from only about 10.5 km in Jammu and Kashmir to about 400 km in Kerala. The national average of road density is about 75 km per 100 sq km. The density of roads is generally high in most of Northern and Southern states. It is low in the Himalayan region, Madhya Pradesh and Rajasthan. This is due to the topography and the level of economic development of the areas. The construction of roads is easy and cheaper in plain areas than in the hilly and plateau regions. Keeping in view the volume of goods traffic and passengers, the road network is not only insufficient, but also inefficient. About 45 per cent of the roads in India are unmetalled and this restricts their use during the rainy season and also for heavy vehicles.

1.1.1.5. Problems of Road Transport

The road transport in India is facing a number of problems. Some of them are as under:

1) About half of the Indian roads are unsurfaced. These can be used only in fair weather and becomes muddy and unfit during the rainy season.
2) Most of the National Highways suffer from inadequate capacity, weak pavements, old and broken bridges, unbridged level crossings, lack of by-pass roads and lack of amenities and safety measures. The mixing of traffic by high speed cars, trucks, buses, tractors, two wheelers, animal driven vehicles, cyclists, etc. increases traffic time, congestion, pollution and road accidents.
3) The existence of multiple check posts, toll tax, and octroi duties collection points on roads waste time and retards the traffic movement and speed.
4) Important amenities, such as repair shops, first aid centres, telephones, clean toilets, food outlets, rest places are lacking along the roads.

Student Notes:

State wise Length of Roads in India

(in km)

Sl. No.	States/UTs	2003	2004	2005	2006	2007	2008	CAGR (%) (2003-08)
1	Andhra Pradesh	201895	206125	329407	336982	339002	345012	11.31
2	Arunachal Pradesh	15661	15712	17751	17216	17430	16494	1.04
3	Assam	160380	192980	208788	215819	223450	230334	7.51
4	Bihar	78750	73834	119958	120127	120127	120127	8.81
5	Chhattisgarh	72729	73993	72322	73892	73705	74434	0.46
6	Goa	10231	10240	10331	10420	10523	10569	0.65
7	Gujarat	142755	143660	143419	144777	145631	146630	0.54
8	Haryana	28511	28673	28657	29055	29397	29726	0.84
9	Himachal Pradesh	32039	32582	23452	23614	34954	36298	2.53
10	Jammu & Kashmir	20272	21095	21811	22043	22058	22323	1.95
11	Jharkhand	11391	11783	18038	18055	18071	17531	9.01
12	Karnataka	199711	200112	210415	214211	253901	255454	5.05
13	Kerala	139590	143276	169516	187147	197454	204757	7.96
14	Madhya Pradesh	164803	165340	163920	164801	165407	165740	0.11
15	Maharashtra	271369	272684	220937	220447	223142	223322	-3.82
16	Manipur	12594	12599	16502	16502	16502	16502	5.55
17	Meghalaya	9564	9701	9662	9691	9752	9839	0.57
18	Mizoram	4913	4898	5426	5974	6144	6158	4.62
19	Nagaland	20523	20647	26241	22085	21947	22304	1.68
20	Orissa	213049	213820	215141	215214	215300	215404	0.22
21	Punjab	40023	45767	46490	45165	45135	45178	2.45
22	Rajasthan	140160	144898	149753	152435	159902	171479	4.12
23	Sikkim	2023	2063	2076	2118	1873	1873	-1.53
24	Tamil Nadu	167450	170823	176209	179348	180823	181213	1.59
25	Tripura	22295	23856	31716	31731	31731	31733	7.32
26	Uttar Pradesh	259928	244442	256683	263555	272362	284673	1.84
27	Uttarakhand	34716	58054	35659	36061	39167	41041	3.40
28	West Bengal	88500	89699	195679	199052	208415	211770	19.07
	State Total	**2565825**	**2633356**	**2925959**	**2977537**	**3083305**	**3137918**	**4.11**
	Union Territories							
1	A & N Island	1181	1481	1298	1301	1303	1301	1.95
2	Chandigarh	1637	1637	2118	2118	2118	2118	5.29
3	D & N Haveli	559	632	632	632	632	632	2.49
4	Daman & Diu	240	318	223	223	223	224	-1.37
5	Delhi	29802	29812	29458	29462	29479	29559	-0.16
6	Lakshadweep	154	160	160	162	166	168	1.76
7	Puducherry	2559	2600	2613	2624	2696	2696	1.05
	UT Total	**36132**	**36640**	**36502**	**36522**	**36617**	**36698**	**0.31**
	India Total	**2601957**	**2669996**	**2962463**	**3014063**	**3119924**	**3174620**	**4.06**

* Excludes Roads Constructed under JRY and PMGSY

Source: 1.Material supplied by TRW, M/o Road Transport & Highways
2.Basic Road Statistics published by TRW, M/o Road Transport & Highways

5) The rules of road safety and traffic are wilfully violated by the drivers and there is no efficient system of checking.

6) The road engineering and construction techniques are out-dated and are not able to meet the challenges of the future.

7) The participation of private sector in road development is very little due to high investments and low returns.

Student Notes:

8) The policy relating to highway development is not stable, as it changes with the change of government.
9) The multiplicity of agencies involved in the planning, construction and maintenance of different types of roads.
10) There is a shortage of funds for the construction and maintenance of roads, even for highways, in India.

1.1.2. Rail Transport

The first train of the world started in 1825 A.D. between Stockholm to Darlington in northern England. Since then, railways became an important means of land transport. Railroad is normally called a ***track***. Distance between two parallel rails is known as ***gauge***. Over sixty percents of world's rail routes are of ***standard gauge*** of 1435 mm. Rail gauge larger than standard gauge is called ***broad gauge*** and smaller than standard gauge is called **narrow gauge**. The measurements of *narrow* and *broad* gauges slightly varies from country to country – narrow gauge between 914 mm and 1067 mm and broad gauge between 1520 mm and 1676 mm [as in India]. Further many countries have 1,000 mm gauge, also known as ***metre gauge***.

1.1.2.1. Advantages of Rail Transport

The major advantages of the rail transport are as follows:

1) It is a cheap means of transport for long distance journeys of people and goods.
2) It is a fast transport for long distances.
3) Due to development of new technology in railway lines, wagons and coaches, engines and operation system, the speed of trains has become more than 300 km per hour. The fast running trains are in vogue in Japan, France and Germany.
4) On account of air-conditioned coaches, excellent arrangement in sleeper coaches and catering travel by trains has become very comfortable.
5) Trains transport heavy and bulky goods over long distances.
6) Trains are convenient mode of transport for sending agro-products to consumers and raw materials to factories.
7) After introduction of big containers, trains and trucks together help the goods to reach at the doorstep of the consumers.
8) Provision of container services has considerably reduced expenses on packing, loading and unloading.
9) Perishable goods are transported in refrigerated wagons.
10) Railways contribute greatly to economic development of a region.

1.1.2.2. Limitations of Rail Transport

Some of the limitations of the modern rail transport are-

1) Huge capital investment is imperative in constructing railway track, stations, platforms and manufacturing wagons and coaches, etc.
2) It is difficult to construct and maintain rail routes in hilly terrains with steep slopes and deserts.
3) Rail transport is generally impossible in areas of heavy rainfall and snowfall.
4) Sending of goods through rail transport becomes difficult due to different gauge of railway lines i.e. broad, metre and narrow. This increases the expenditure on loading and unloading.

1.1.2.3. Distribution of Railways in the World

The network of rail routes is unevenly distributed across the world. The economically developed countries of the world have more railways. Railways have played an important role in the industrialisation of these countries. The colonial rulers of Europe connected the interior parts of

their colonies in Asia and Africa to the ports. The main purpose of this was to bring the raw material from the interior of these colonies to the ports, which was later shipped to European countries. This was the main purpose behind connecting Delhi to Kolkata, Mumbai and Chennai. Similar course was followed in Africa by the French, Italians and other colonial powers.

Later, most of the cities were connected by the railway networks. Parts of Europe have great density of railway network. It is said that Belgium has the world's densest rail route network It has 1 km railway lines for every 6.5sq km area. In Asia the countries of Japan, China and India are densely populated. They have also dense network of railways. In other countries railways are not widespread. West Asia is least developed in rail networks because of existence of vast deserts and thinly populated regions. Very recently China has constructed railway line up to Lhasa in Tibet. The Qinghai-Tibet railway is the highest altitude railways of the world. Another project, **Trans-Asian Railway** (TAR) undertaken by the United Nations Economic and Social Commission for Asia and Pacific [UNESCAP] integrates freight railway networks across Europe and Asia. North America has the densest rail route network in the world. About 40 per cent rail routes of the world are found in this continent. Very heavy load like minerals, food grains, logs of timber etc. are transported by railways. Passengers, however, prefer air journey or road journey.

Intercontinental rail routes connect two ends of a continent. These rail routes are constructed from the political, economic and military points of view. Important among these routes are given below:

(i) Trans-Siberian Railway: This route was constructed for connecting European Russia to Siberia or Asian Russia and runs from St. Petersburg in the west to Vladivostok on the Pacific Coast in the east passing through Moscow, Ufa, Novosibirsk, Irkutsk, Chita and Khabarovsk. It is the most important route in Asia and the longest (9,332 km) double-tracked and electrified trans– continental railway in the world. It has helped in opening up its Asian region to West European markets. Its development is on account of economic, political and defence reasons.

(ii) Canadian Pacific Railway: This 7,050 km long rail-line in Canada runs from Halifax in the east to Vancouver on the Pacific Coast passing through Montreal, Ottawa, Winnipeg and Calgary. This was constructed for connecting British Columbia (an eastern Province) to other states of Canada. Later on, it gained economic significance because it connected the Quebec-Montreal Industrial Region with the wheat belt of the Prairie Region and the Coniferous Forest region in the north. Thus each of these regions became complementary to the other.

(iii) Australian Intercontinental Rail Route: The main purpose of constructing this was to connect the Western Australia to east Australian states so as to keep it within the union.

(iv) The Union and Pacific Railway: This rail-line connects New York on the Atlantic Coast to San Francisco on the Pacific Coast passing through Cleveland, Chicago, Omaha, Evans, Ogden and Sacramento. The most valuable exports on this route are ores, grain, paper, chemicals and machinery.

(v) Trans-Asiatic Railway: A UN assisted rail project for linking Istanbul with Bangkok via Iran, Pakistan, India, Bangladesh and Myanmar has been pending since a very long time.

1.1.2.4. Distribution of Railways in India

The network of the Indian Railways is the largest in Asia and fourth largest in the world. It is the life-line of the country catering to its need for large-scale movement of traffic, both passengers and freight. Mahatma Gandhi said, the Indian railways *"brought people of diverse cultures together to contribute to India's freedom struggle."*

Student Notes:

Indian Railway was introduced in 1853, when a line was constructed from Bombay to Thane covering a distance of 34 km. Indian Railways is the largest government undertaking in the country. The length of Indian Railways network is about 64,000 km. It's very large size puts lots of pressure on a centralised railway management system. Thus, in India, the railway system has been divided into sixteen zones.

Student Notes:

On the basis of *width of the track* of Indian Railways, three categories have been made:

Broad Gauge: The distance between the rails in the broad gauge is 1.676 metres. The total length of broad gauge line is about 46,800 km, which accounts for about 74 per cent of the total length of rail routes in the country.

Metre Gauge: The distance between the rails in the metre gauge is one metre. The total length of the metre gauge line is about 13,300 km, which accounts for about 21 per cent of the total length of rail routes in the country.

Narrow Gauge: The distance between the rails in the narrow gauge is 0.762 metre or 0.610 metre. The total length of the narrow gauge is about 3,124 km, which accounts for about 5 per cent of the total length of rail routes in the country. The narrow gauge is generally confined to hilly areas.

The Government of India has nationalised the railways and adopted a policy of gauge conversion, mainly from metre gauge to broad gauge. The **unigauge** system of railways will assure larger capacity, higher speed and consequently cheaper transportation. The process of gauge conversion is very slow due to the shortage of funds and it will take many more years to bring the total railway system under single gauge.

The distribution of Indian Railway network has been influenced by the geographical, economical and political factors. The Northern Plains of India with level land, high density of population, fertile soils and intense agriculture activities presents the most favourable environment for the development of railways. The relief of Himalayas and the plateaus is not suitable for the large scale development of railway network. The development of railways is more in economically active areas. Railways also bring economic development and prosperity to those regions through which they pass. Due to this economic link, we find the highest density of railways near big urban and industrial centres, and also in areas which are rich in minerals and agricultural resources. The present railway system in India is the legacy of British Rule. They planned the pattern of the railway network according to their needs.

1.1.2.5. Problems of Railways in India

Railways being the largest public sector undertaking has varied and complex problems. Some of them are as under:

1) Its present railway network is overburdened and inadequate to meet the new challenges of a fast developing economy.
2) Some regions are beyond the reach of railways due to unfavourable geographical conditions. These areas need to be opened to railways for removing regional inequalities in economic growth.
3) Railways are facing stiff competition from road transport and thus its share in passenger and goods traffic is declining.
4) Railways are overburdened with surplus staff on its regular pay roles. This burden hinders the further development of railways.
5) The railways have to develop uneconomic projects due to political pressures and interferences.
6) Railways have huge outstanding payments to diesel and electric power supply companies.
7) The State Electricity Boards and NTPC increase the tariffs arbitrarily and thus add to the burden of railways.

Student Notes:

8) Railways are the largest consumer of diesel. Any increase in the rates of diesel, adversely affect the financial resources.
9) Most of the equipment used by the railways are now obsolete and need immediate replacements.
10) There is mounting deficit due to non increase in fares and tariffs by the Government due to political reasons.

Despite these problems and shortcomings, there is no other substitute for railways, as these are 5 times more energy efficient and four times more economical than road transport. In the last few years, some administrative changes have been implemented to reduce the deficit. As a result of consistent efforts, the Indian Railways are now generating surplus funds. Some of the measures taken include sharpening of marketing capability; Strengthening of high density network; Cutting down of unnecessary overheads; Commercial exploitation of railway lands; Participation by the private sector; and Effective and efficient use of available financial resources.

1.2. Water Transport

Man has been using water transport since ancient times. Waterways were being used mainly for transporting goods for the last few years. But now, big passenger ships are moving from one corner of the world to another with the load of thousands of tourists. Water transport is *the* cheapest as compared to other means of transport because no cost is involved in constructing the roads or on their maintenance. Waterways are highly suitable for heavy and bulky materials. Waterways are of two types: (i) Inland Waterways, and (ii) Ocean Waterways.

1.2.1. Inland Waterways

The rivers, lakes and canal used for transporting goods or people are called inland waterways. The inland waterways were very important before the invention of trains and motor vehicles. They were very much in use for transporting passengers and goods. But, rail routes and roads have reduced their importance to some extent.

1.2.1.1. Necessary Conditions for Inland Waterways

The following are the necessary conditions which need to be met for successful inland water transport in the country.

1) Rivers should be perennial or water should flow in sufficient quantity throughout the year. Seasonal rivers are unsuitable for navigation.
2) Water transport cannot take place in river having rapids or waterfalls.
3) The water in rivers, lakes and canals should not freeze during winter season.
4) Soil or sand should not be deposited on the mouth of rivers. The deposition of sand or soil reduces the depth of water.
5) The course of rivers should not be full of curves. These curves increase the time of transportation.
6) Rivers should not change their courses during floods.

1.2.1.2. Advantages of Inland Waterways

Inland waterways are advantageous in many ways. These can be summarised as –

1) Transportation of heavy and bulky goods is easy and cheap. Coal, different ores, wood and big size manufactured goods are suitable for water transport.
2) Rivers and lakes are natural routes. Expenditure on their construction and maintenance is not required.
3) Waterways experience comparatively few accidents.
4) Rivers are the only means of transport in thick forested lands of heavy rainfall.

Student Notes:

1.2.1.3. Limitations of Inland Waterways

In spite of the above mentioned advantages, the inland waterways have following limitations-

1) Time is lost due to slow speed. Hence, they are not suitable for transporting perishable goods such as fruits, vegetables and milk and their by products.
2) Most of the rivers flow far away from the densely populated areas where demand for transportation is more. Hence, this mode of transportation presents difficulties.
3) Seasonal change in the flow and depth of water creates problem in transportation
4) For keeping desired depth in the rivers, lakes and canals, silting of sand and soil is to be removed regularly. This involves expenditure and the navigation is halted during such an exercise.

1.2.1.4. Distribution of Inland Waterways in the World

All the rivers and lakes of the world are more or less used for transportation. But, navigable rivers which pass through densely populated areas are more used for navigation. The major inland water ways used extensively round the globe can be studied as follows-

Rhine Waterway: Rhine River flows through industrial The Rhine flows through industrially advanced nations of Switzerland, Germany, France, Belgium and the Netherlands. The Rhine River is navigable from Rotterdam for about 870 km. At its source in Switzerland, it flows along boundary of France and Germany and drains Germany and the Netherlands and has its mouth near North Sea. On its banks are located main cities of Europe like Strasbourg {France}, Bonn, Cologne, Dusseldorf and Rotterdam. The vessel take the cargo of industrial products, coal food grains in addition to passengers and tourists which have seen considerable rise in the past few decades. For the benefit of tourists, the vessels are fitted with modern conveniences and sail in both directions of the rift valley. One can enjoy the scenic beauty of the Vossages of France and Black Forest of Germany. Each year more than 20,000 ocean-going ships and 2, 00,000 inland vessels sail in this waterway.

Danube Waterway: It is an important inland waterway of Eastern Europe. The Danube rises in the Black Forest of Germany and flows eastwards through Austria, Slovak Republic, Hungary Croatia, Bulgaria, Romania and other countries and then joins the landlocked Black Sea. It is 2,850 km long. In 1992, a 171 km canal was constructed linking it with **Kohlheim.** Now Danube covers a distance of 3,500 km to fall into Black Sea. Cargoes carrying export items are wheat, maize, timber, and machinery sail in the river. The waterway is also gaining importance on account of rising tourism.

Great Lakes· St. Lawrence Seaway: This waterway flows through the industrially advanced region and estuary St. Lawrence River of the United States and Canada. It is therefore the longest and busiest inland waterway of the world. Ships can ply up to a distance of 3760 km in it. The ships plying on this route are long and narrow and are capable of transporting 45,000 tonnes of freight. Agro-products, machines, iron ore, coal, petroleum, limestone, etc. are mainly transported from the ports like Duluth and Buffalo, which are equipped with all modern facilities. The Great Lakes region of North America consists of Lakes Superior, Michigan, Huron, Erie and Ontario.

Mississippi Waterway: Mississippi River is one of the main rivers of North America. It has its source in Lake Itasca in Minnesota and flow 3,718 km draining fertile lands of interior parts of North America. It then joins the Gulf of Mexico. This waterway has become more important these days. About 16 km north its tributary Saint Louis Missouri joins it. Together with Missouri, its total length is 6238 km. For greater part it is navigable. Steamers can ply in this river up to Minneapolis some distance away from Lake Superior. The Mississippi-Ohio waterway connects the interior part of U.5.A with the Gulf of Mexico in the south.

Student Notes:

Volga Waterway: Volga is Europe's biggest river and has large number of developed waterways. After rising from in the Valdai Hills north-west of Moscow, it flows for about 3689 km before draining into Caspian Sea. Oaka River is its major right bank tributary. The river is connected to river Don by a canal which flows into the Black Sea.

1.2.1.5. Distribution of Inland Waterways in India

The inland waterways refer to using inland water bodies, such as rivers, canals, creeks, backwaters, etc. for transporting goods and people from one place to another. A number of rivers, like Ganga, Brahmaputra Yamuna, Mahanadi, Godavari, Krishna, Kaveri, Narmada, Tapi, etc. were the main arteries of inland waterways in India. At present, the inland waterways in India are about 14,500 km in length, contributing about 1% to the country's transportation. Out of this about 3,700 km are navigable by mechanised boats.

In order to increase the significance of inland waterways and to improve their efficiency, the **Inland Waterways Authority of India** (IWAI) was set up in 1986. The following inland waterways have been declared is the **National Waterways** by the IWAI. There are six identified national waterways in India.

National waterway-1: Allahabad–Haldia stretch of the Ganges–Bhagirathi–Hooghly River of total length 1620 km was declared as National Waterway-1 (NW-1) in the year 1986. The Hooghly river portion of the waterway from Haldia to Nabadwip is tidal. Sea going vessels navigate up to Calcutta (140 km) and the fairway up to Calcutta is maintained by the Calcutta Port Trust. From Calcutta up to Tribeni there are no restrictions for navigation by inland vessels of a loaded draft up to 4m.From Farakka upstream the navigable route is through the main Ganga River. The Feeder Canal and the navigation lock at Farakka become the link between the Bhagirathi and main Ganga upstream Farakka Barrage. The large variation in discharge along with unstable morphological condition of bank and bed, heavy sediment load, continuous braiding and meandering make development of navigational channel a complex task.

National Waterway-2: Sadiya–Dhubri stretch of the Brahmaputra River of total length 891 km was declared as National Waterway-2 (NW-2) in the year 1988. The river Brahmaputra flows down the centre of Assam Valley. It receives a number of tributaries like Subansiri,Jia Bharali, Dihing, Burhi Dihing, Disang, Dhansiri and Kopili.

National Waterway-3:

Kollam–Kottapuram stretch of West Coast Canal and Champakara and Udyogmandal canals of total length 205 km was declared as National Waterway-3 (NW-3) in the year 1993. This waterway comprises of natural lakes, back-waters, river sections and man-made canal sections. The Champakara and Udyogmandal canals link industrial centres of Ambalamugal and Udyogmandal with the Kochi port.

National Waterway- 4:

Kakinada–Pondicherry stretch of canals and Kaluvelly tank, Bhadrachalam–Rajahmundry stretch of River Godavari and Wazirabad–Vijayawada stretch of River Krishna of total length 1095 km was declared as National Waterway-4 (NW-4) in the year 2008.

Student Notes:

National Waterway-5:

Talcher–Dhamra stretch of rivers, Geonkhali–Charbatia stretch of East Coast Canal, Charbatia–Dhamra stretch of Matai river and Mahanadi delta rivers of total length 620 km was declared as National Waterway-5 (NW-5) in the year 2008.

National Waterway-6:

Lakhipur-Bhanga stretch of 121 km of the Barak River is the 6th waterway. It will result in unified development of the waterways for shipping and navigation and transportation of cargo to the North Eastern Region particularly in the states of Assam, Nagaland, Mizoram, Manipur, Tripura and Arunachal Pradesh. It was accepted as National Waterway in January 2013 by Union Cabinet.

Uttar Pradesh has the highest length of inland waterways, followed by West Bengal, Andhra Pradesh, Assam, Kerala and Bihar.

1.2.2. Oceanic Routes

The oceans are linked with each other and are for most parts negotiable. Ocean transport plays a significant role in international trade. Most of the crude oil from the oil producing countries of the world is exported through oil tankers. The transportation of agro-products, processed foods and manufactured goods including all heavy and bulky goods are moved through ocean routes.

1.2.2.1. Main Ocean Routes of the World

Student Notes:

North Atlantic Ocean Route: It is one of the busiest sea routes in the world. It is also known as Big Trunk Route. Approx 25 per cent of the ships of the world ply on this route. The main ports of Western Europe are Glasgow and London (U.K.), Rotterdam (Netherlands), Antwerp (Belgium), I.e. Havre and Bordeaux (France). Main ports of North America are: Quebec and Montreal (Canada); Boston, New York and Baltimore (U.S.A.). Goods shipped from Europe to Canada and the U.S.A includes manufactured goods like clothes, chemicals, fertilisers, wines etc. From Canada and the U.S.A to Europe, items include food grains, iron and steel, transport equipment etc.

Mediterranean-Red Sea-Indian Ocean Route: This route connects Eastern Africa, Southern Asia and countries of Far East to West European countries. This is a very important ocean route of the world. It passes through North Sea, Atlantic Ocean Mediterranean Sea, Red Sea, Arabian Sea, Indian Ocean and South China Sea. The Suez Canal route has reduced the distance 6,400 km. Main Ports include Port Said, Aden, Karachi, Mumbai, Kochi, Colombo, Singapore and Bangkok. Materials moving towards East constitute mainly machines and industrial products etc. while materials moving towards West are raw materials, cotton, tea, coffee, sugar, rubber, petroleum, etc.

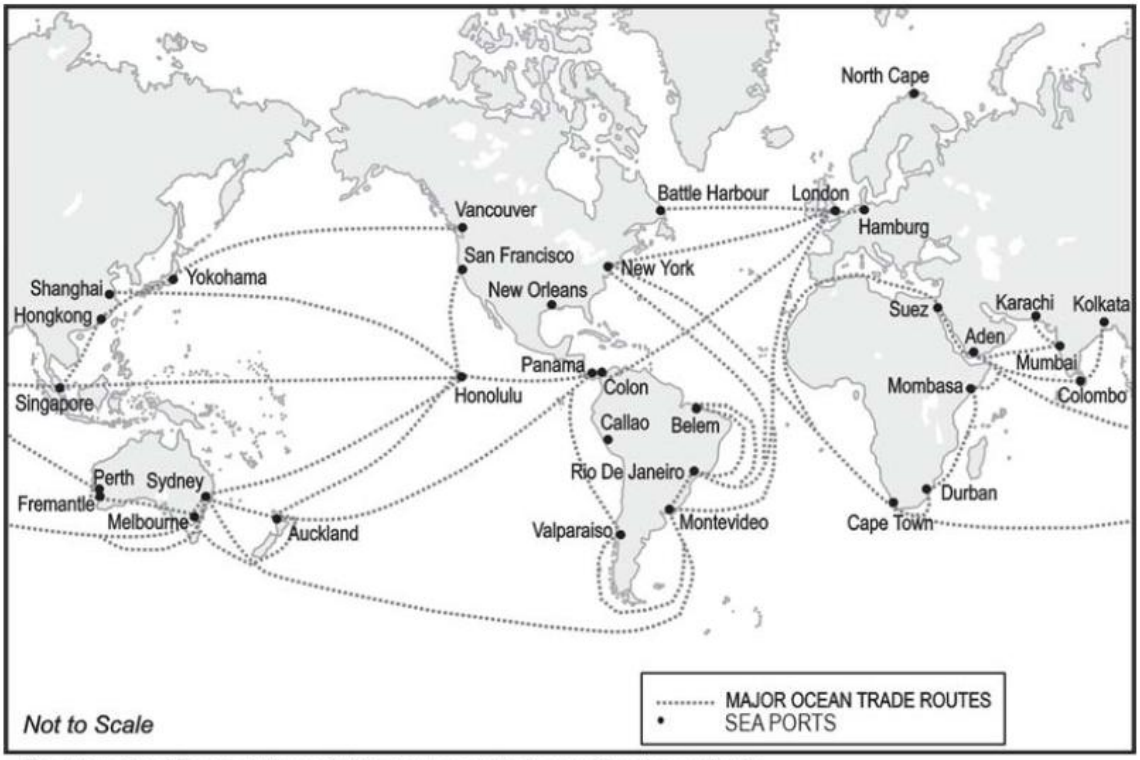
Cape Ocean Route (Cape of Good Hope Route): Before the opening of Suez Canal Route, Europeans used to pass through this route while visiting India, China and Australia. Still, this route connects Western Africa, South Africa, Australia and New Zealand to Western Europe for trade, these days. Main Ports in this route are London, Lisbon, Cape Town, Adelaide, Melbourne, Sydney, Wellington (New Zealand). Palm-oil, wood, almond and copper are sent to Europe from Africa while wheat, maize, wool, etc. are sent to Africa from Australia. Industrial products are sent from Europe to Africa and Australia.

South Atlantic Route: The trade between the countries of South America and Europe is being carried out through this route. Brazil, Argentina, Uruguay are the main countries of South America benefitted by this route. This route is comparatively less important. Quantity of trade is less because of the underdeveloped West African countries. Main Ports on this route include London, Liverpool, Hamburg (Europe) Kingston, Havana (West Indies) Rio-de Janeiro (Brazil, Buenos Aires (Argentina), Montevideo (Uruguay). Materials transported include coffee, rubber, sugar, meat, wool, wheat, are sent from countries of South America and West Indies to Europe. Coal, machines and industrial products are sent from Europe to these countries.

North Pacific Ocean Route: This route is used for trade between western regions of North America and Japan; and China and Far East Asia. These ocean routes are lengthy route and lack facilities of harbours and refilling fuels. Main Ports include Yokohama, Tokyo, Shanghai and Manila in East Asia and San Francisco, Seattle and Los Angeles in Western North America. Goods Transported are silk and tea from Japan, wool and different minerals from Australia are sent through this route to North America. In return, North America sends wood, cereals, petroleum and finished goods to Australia, Japan and New Zealand.

Student Notes:

Major Sea Routes round the world



The International Boundary shown in this map may not to be considered as authentic

1.2.2.2. Main Shipping Canals

Shipping canals are canals especially intended to accommodate ships used on the oceans, seas or lakes to which it is connected. As opposed to it, a barge canal is intended to carry barges and other vessels specifically designed for river and/or canal navigation. Because of the constraints of accommodating vessels capable of navigating large bodies of open water, a ship canal typically offers deeper water. Ship canals are constructed for a number of reasons which include creating a shortcut and avoiding lengthy detours; to create a navigable shipping link between two land-locked seas or lakes; to provide inland cities with a direct shipping link to the sea; and to provide an economical alternative to other options.

List of Important Shipping Canals in the World

Canal	Length	Lock depth	Dimension	Location	Notes
White Sea – Baltic Canal	141 mi (227 km)	3.5 m (11 ft)	135m × 14.3 m × 3.5m	Russia	Opened in 1933, is partly a canalised river, partly an artificial canal, and partly some natural lakes. Shallow depth limits modern vessels from using the canal.
Rhine-Main-Danube Canal	106 mi (171 km)	4 m (13 ft)	lock dimensions: 190m x 11.45m x 4m	Germany	Opened in 1992, links the large rivers Rhine and Danube, and thus also the North Sea and the Black Sea.
Suez Canal	120.11 mi	No	205 m		Opened in 1869, links

	(193.30 km)	locks, but 24 m (79 ft) deep.	(673 ft) wide	Egypt	the Mediterranean Sea to the Red Sea.
Volga-Don Canal	62 mi (100 km)	3.5 m (11 ft)	lock dimensions: 140m x 16.6m x 3.5m	Russia	Opened in 1952, connects the Black, Azov, and Caspian Seas.
Kiel Canal	60 mi (97 km)	14 m (46 ft)	lock dimensions: 310m x 42m x 14m	Germany	Opened in 1895. Shortens the passage between the North Sea and the Baltic Sea.
Houston Ship Channel	56 mi (90 km)	14 m (46 ft)	161 m (528 ft) wide	USA	Connects Houston, Texas to the Gulf of Mexico.
Panama Canal	51 mi (82 km)	25.9 m (85 ft)	lock dimensions: 320m x 33.53m x 25.9 m	Panama	Opened in 1914. Links the Caribbean Sea to the Pacific Ocean, creating a shortcut.
Danube-Black Sea Canal	40 mi (64 km)	5.5 m (18 ft)	lock dimensions: 138m x 16.8m x 5.5m	Romania	Opened in 1984. Links the Danube to the Black Sea.
Manchester Ship Canal	36 mi (58 km)	8.78 m (28.8 ft)	lock dimensions: 170.68m x 21.94m x 8.78m	UK	Opened in 1894. Links the in-land city of Manchester to Irish Sea.
Welland Canal	43.4 km (27.0 mi)	8.2 m (27 ft)	lock dimensions: 225.5m x 23.8m x 8.2 m	Canada	Opened in 1931. Links Lake Erie to Lake Ontario and is part of the Saint Lawrence Seaway.
Saint Lawrence Seaway		8.2 m (27 ft)	lock dimensions: 225.5m x 2.3m x 8.2 m	Canada USA	Links Montreal with Lake Superior.

1.2.2.3. Oceanic Routes in India

The coastline of the mainland of India and of the islands is about 7,517 km long. India had a flourishing maritime trade even during the ancient days with East Indies and Middle East countries. The shipping got a setback with the arrival of European companies during the colonial rule.

Student Notes:

Student Notes:

India has 13 major ports and 176 non-major ones. The major ports carry about 3/4th of the total traffic. Despite adequate capacity and handling facilities the average turnaround time of major Indian ports is less than 4 days which is very high compared to the average turnaround time of about 10 hrs in Hong Kong. This undermines the competitiveness of Indian ports. Since the ports are not adequately linked to the Hinterland, the evacuation of CARGO is slow leading to congestion. To this end, all ports trust have set up groups with representatives from the National Highway Authority of India(NHAI), Railways and State Governments to prepare comprehensive plans aimed at improving road-rail connectivity of ports. The NHAI has taken up port connectivity as major component of the National Highways Development Project (NHDP).

1.2.2.3.1. Problems of Shipping in India

The Indian shipping industry is facing a number of problems. Some of them are as under:

1) Inadequacy of tonnage capacity.
2) Shortage of container fleet.
3) Over-aged vessels resulting in high operation costs.
4) Stiff competition with foreign shipping companies which provide better and cheaper service.
5) Congestion at the major ports, and
6) Inadequate infra-structural support like ship-repair facility, dry-docking and cargo handling.

1.2.3. Major Ports in India

The 13 major ports of India handle more than 95 per cent of our foreign trade by volume and 70 per cent by value. The major ports are Kandla, Mumbai, Jawaharlal Nehru (Nhava Sheva), Mormugao, New Mangalore, Kochi, Tuticorin, Chennai, Vishakhapatnam, Paradip, Haldia, Kolkata and Port Blair. Details of some of these ports are as follows-

1) Kandla: Kandla port was developed soon after independence to make up the loss of Karachi to Pakistan. It is a tidal port and is located at the eastern end of the Rann of Kachchh. It handles the exports and imports for Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, Rajasthan and Gujarat. It handles crude oil, petroleum products, cotton, fertilizers, food grains, cement, sugar, edible oils, scrap, etc.

2) Mumbai: It is the biggest natural harbour on the west coast of India. The opening of Suez Canal in 1869 brought it much closer to the European countries. A new port Nhava Sheva has been developed near Mumbai port. It has decongested traffic at Mumbai port. It handles a large variety of cargo from Middle-East and European countries. It serves as a hub port in this region.

3) Mormugao: Mormugao port is an important port of Goa and handles the iron ore export from India. It is located on the entrance of the Zuari estuary. With the opening of Konkan Railway, its importance has been enhanced and it is working as a multi-commodity port.

4) New Mangalore: It is a new port developed about 9 km north of the old port. The port is well linked with Mumbai and Kanyakumari. The main items of cargo from this port are iron ore, manganese ore, fertilizers, tiles, cement, coffee, cashew nuts, forest products, food grains, etc.

5) Kochi: It is a natural port located along the coast of Kerala and is popularly known as *"Queen of the Arabian Sea*". Kochi has sheltered backwater bay, and is open to traffic throughout the year. The main items of export and import are coir goods, copra, coconut oil, tea, rubber, spices, cashew kernels, sea food, chemical fertilizers, etc. The Kochi Oil Refinery receives crude oil from this port.

6) Tuticorin: It has been recently developed along the south-eastern coast of Tamil Nadu. It has an artificial deep sea harbour and is well connected with railways and roads. Main

exports and imports are tea, spices, cotton textiles, hides and skins, edible oils, sugar, petroleum products, etc.

7) **Chennai:** It is the oldest artificial harbour on the east coast of India. It is often hit by cyclones in October and November, making the shipping difficult. It is not suited for large ships due to lesser depth of water. This port mainly handles petroleum products, fertilizers, iron ore, coal, edible oils, machinery, cotton, metals, etc.
8) **Vishakhapatnam:** It is the deepest, land-locked, protected and the best natural harbour of India. An outer harbour has been developed to handle iron ore and petroleum. It also has the shipbuilding and ship-repair industry. Its main imports and exports are petroleum, fertilizers, chemical, machinery, metals, iron ore, timber, leather goods and food grains.
9) **Paradip:** It is deep water and all weather port, located about 100 km east of Cuttack. It has the deepest harbour in the country. This port handles iron ore and coal along with some dry cargo. The port is well connected through rail and road with different parts of Orissa.
10) **Kolkata-Haldia:** It is situated along the Hugli River about 148 km away from sea shore. It is one of the leading ports of India. Its importance has slightly declined due to the development of Paradip and Vishakhapatnam ports. Kolkata is a truncated port and has two dock systems-Kidderpore Docks and Netaji Subhash docks. Recently in 1978, another port Haldia (90 km downstream from Kolkata) has been developed, for handling the bulk cargo, and to relieve pressure on the old port. The port handles petroleum, chemicals, edible oils, railway equipment, machinery, tea, sugar, gunnies, leather goods, lac, mica, scrap, etc.

1.2.4. Types of Port

Generally, ports are classified according to the types of traffic which they handle. Types of port according to cargo handled:

(i) ***Industrial Ports:*** These ports specialise in bulk cargo-like grain, sugar, ore, oil, chemicals and similar materials.
(ii) ***Commercial Ports:*** These ports handle general cargo-packaged products and manufactured goods. These ports also handle passenger traffic.
(iii) ***Comprehensive Ports:*** Such ports handle bulk and general cargo in large volumes. Most of the world's great ports are classified as comprehensive ports.

1.2.5. Types of port on the basis of location

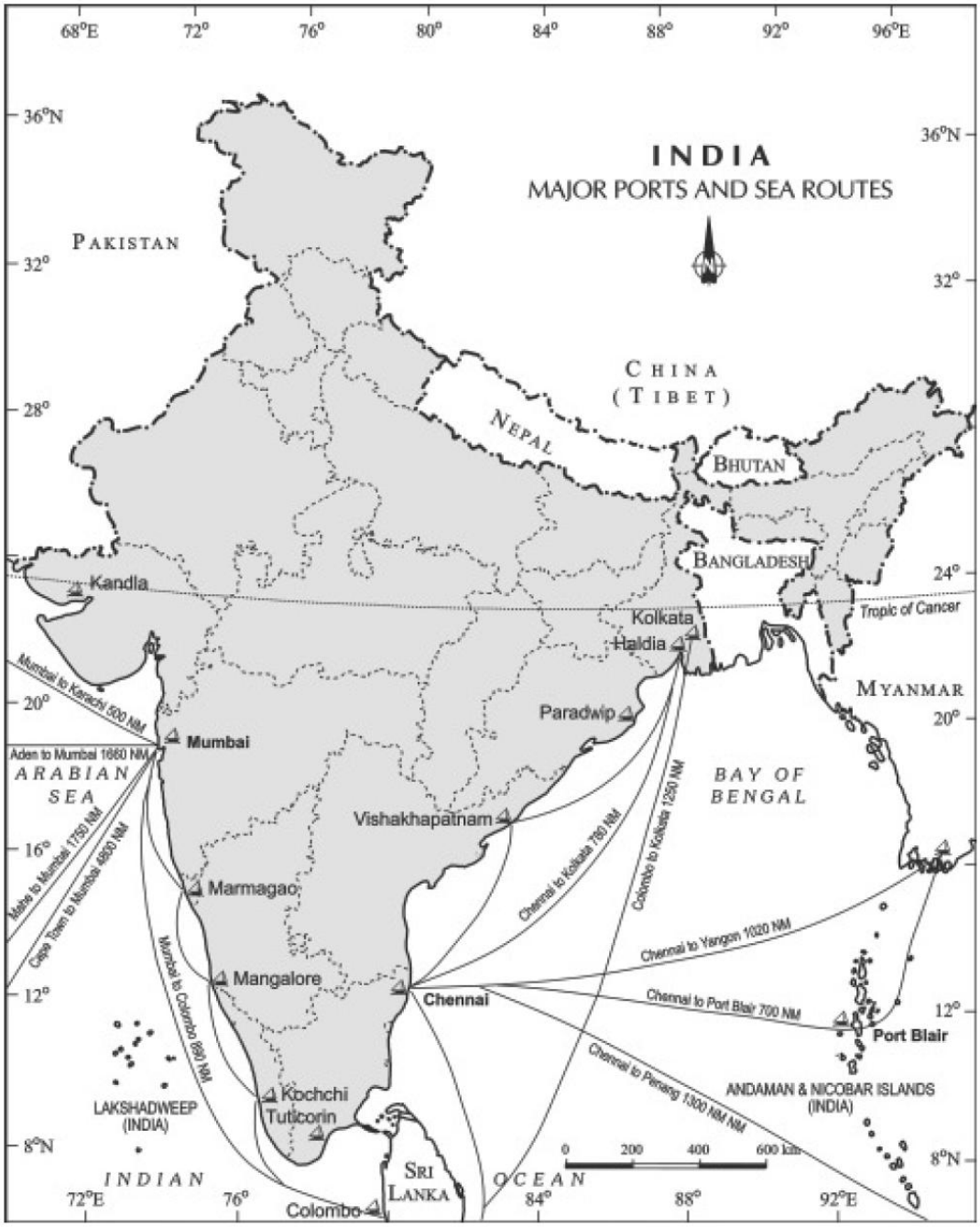
(i) ***Inland Ports:*** These ports are located away from the sea coast. They are linked to the sea through a river or a canal. Such ports are accessible to flat bottom ships or barges. For example, Manchester is linked with a canal; Memphis is located on the river Mississippi; Rhine has several ports like Mannheim and Duisburg; and Kolkata is located on the river Hooghly, a branch of the river Ganga.
(ii) ***Out Ports:*** These are deep water ports built away from the actual ports. These serve the parent ports by receiving those ships which are unable to approach them due to their large size. Classic combination, for example, is Athens and its out port Piraeus in Greece.

1.2.6. Types of port on the basis of specialised functions

(i) ***Oil Ports:*** These ports deal in the processing and shipping of oil. Some of these are tanker ports and some are refinery ports. Maracaibo in Venezuela, Esskhira in Tunisia, and Tripoli in Lebanon are tanker ports. Abadan on the Gulf of Persia is a refinery port.

Student Notes:

Student Notes:



(iii) ***Ports of Call:*** These are the ports which originally developed as calling points on main sea routes where ships used to anchor for refuelling, watering and taking food items. Later on, they developed into commercial ports. Aden, Honolulu and Singapore are good examples.

(iv) ***Packet Station:*** These are also known as *ferry ports.* These packet stations are exclusively concerned with the transportation of passengers and mail across water bodies covering short distances. These stations occur in pairs located in such a way that they face each other across the water body, e.g. Dover in England and Calais in France across the English Channel.

(v) ***Entrepot Ports:*** These are collection centres where the goods are brought from different countries for export. Singapore is an entrepot for Asia. For e.g. Rotterdam for Europe, and Copenhagen for the Baltic region

(vi) ***Naval Ports:*** These are ports which have only strategic importance. These ports serve warships and have repair workshops for them. Kochi and Karwar are examples of such ports in India.

1.3. Air Transport

Student Notes:

Air transport is the fastest means of movement from one place to the other. It has reduced distances by minimising the travel time. It is very essential for a vast country like India, where distances are large and the terrain and climatic conditions are diverse.

Air services can be further classified into two type's i.e. (i) domestic air services; and (ii) international services. The domestic air services provide air services by transporting passengers and goods from one part to another part within the same country; whereas international services provide connection between two or more countries.

1.3.1. Important Air Routes of the World

Generally, all the countries of the world have their own airways. But, air routes are well developed in industrially advanced countries because aeroplanes get more passengers and goods for air transport in these countries. Airlines earn a lot of profit in such countries. Areas of Dense Air routes cover Western Europe, South Eastern Canada and Eastern United States of America and South and South East Asia. Air services for different directions are available at many cities of the world.

1.3.2. Air Transport in India

Air transport in India made a beginning in 1911 when airmail operation commenced over a little distance of 10 km between Allahabad and Naini. But its real development took place in post-Independent period. In 1947, there were four companies, namely 1 Indian National Airways; 2 Tata Sons Limited, 3 Air Services of India, and 4 Deccan Airways.

The Airport Authority of India is responsible for providing safe, efficient air traffic and aeronautical communication services in the Indian Air Space. The authority manages 125 airports including 11 international, 86 domestic and 29 civil enclaves at defence air fields. To enhance airport infrastructure in India, modernization of existing airport infrastructure in metro and non-metro cities and construction of Greenfield airports were contemplated. The Twelfth Five Year Plan (2012-17) envisages an investment of Rs. 65,000 crore at Indian airports, of which a contribution of about Rs. 50,000 crore is expected from the private sector. The air transport in India was managed by two corporations, Air India and Indian Airlines after nationalisation. Now many private companies have also started passenger services. *Air India* provides International Air Services for both passengers and cargo traffic. It connects all the continents of the world through its services.

Domestic passenger traffic handled at Indian airports reached 106 million during January to November 2012; while the International passenger traffic handled at Indian airports was placed at 37.8 million during January- November 2012. International cargo throughput at Indian airports during January-November 2012 was 1.30 MMT as compared to 1.37 MMT during the previous year. Domestic cargo throughput during January- November 2012 stood at 0.73 MMT.

The Government of India approved a *Turn Around Plan* (TAP) and a Financial Restructuring Plan (FRP) for improving the operational and financial performance of Air India (AI) in April 2012. The company has taken several initiatives towards cost cutting and revenue enhancement during the year 2011-12, covering 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 from the company's real estate properties. The TAP also included operationalization of subsidiary companies in ground handling and MRO and transfer of manpower and equipment so that these could be treated as independent profit centres.

1.4. Pipeline Transport

Student Notes:

Pipelines were used to supply water cities, factories, etc. till recently. But, nowadays, pipelines are used in transporting liquid materials mainly petroleum and its products, natural gas, slurry of iron ore and coal and even milk.

1.4.1. Advantages of Pipeline Transport

The pipeline transport provides many advantages in transport of fluid products across various centres for trade. Their salient features include-

1) It is a cheap means of transport for liquid goods.
2) Maintenance expenditure is less as compared to other modes of transport after they are laid.
3) It is possible to lay pipelines even in inaccessible and undulating areas.
4) This mode of transport is not affected by bad weather conditions.
5) There is no problem of leakage, damage and accidents in pipeline transport.

1.4.2. Limitations of Pipeline Transport

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.

1.4.3. Distribution of Pipelines in the World

The areas of the world with dense network of pipelines are as under:

(i) **United States of America** has dense network of pipelines. Most of the pipelines transport petroleum products and natural gas from the coastal areas like Gulf of Mexico to the consuming areas of north east. The total length of pipelines in USA in 2007 was 8,00,000 km. In Canada (1, 00,000 km) and Mexico (40,016 km), pipelines are also important means of transport. The most famous pipeline of the United States is called 'Big Inch'. It carries mineral oil from oil wells of Gulf of Mexico to north-eastern parts.

(ii) In many **European countries**, petroleum products and natural gas is transported through pipelines. The oil of North Sea is distributed through pipelines on the main land of the continent. Russia in 2007, alone has 2, 44,000 km long pipelines. Pipeline transport is also important in Germany and France. COMECON, 4800 km long is the longest pipeline of the world. It transports mineral oil from Volga and Ural in Russia to East European countries.

(iii) **Middle East Asia:** Oil is transported through pipelines from Saudi Arabia (6550 km), Iraq and other countries to refineries located on the Mediterranean coast. In Iran 9,800 km long pipeline exists.

(iv) **Central Asia:** The oil producing countries of central Asia i.e. Azerbaijan, Turkmenistan and Kazakhstan supply petroleum and natural gas through many pipelines to Turkey and Russia. Thousand kilometres long pipelines are under construction in this region.

1.4.4. Pipeline Transport in India

Pipeline transport in India dates back to 1959 when Oil India Limited (OIL) was incorporated as a company. Asia's first cross country pipeline covering a distance of 1,157 km was constructed by OIL from Naharkatiya oilfield in Assam to Barauni refinery in Bihar. Other extensive network of pipelines has been constructed in the western region of India of which Ankleshwar-Koyali, Mumbai High- Koyali and Hazira-Vijaipur-Jagdishpur (HVJ) are most important. Recently, a 1256 km long pipeline connecting Salaya (Gujarat) with Mathura (U.P.) has been constructed. It supplies crude oil from Gujarat to Punjab (Jalandhar) via Mathura.

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.
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 offshore terminal for imported crude oil.
4. **Hajira-Vijapur-Jagdishpur (HVJ) 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 Vijapur 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.
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 Rs. 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 equivalent to transporting 3.5 lakh LPG gas cylinders across 1,269 km every day and its capacity is being increased to 5.0 lakh cylinder per day.
6. **Kandla-Bhatinda Pipeline:** This 1,331 km long pipeline is proposed to be constructed for transporting crude oil to the proposed refinery at Bhatinda. It is to be constructed by IOC at the estimated cost of Rs. 690 crore.

2. Communication

Earlier, means of transport and communication were the same. Transfer of information was done by man or animals or birds. Inventions of telegraph and telephone have given a new shape to communication system. But the revolution in the field of communication came after the invention of radio and television. This has made impossible things possible.

Major revolution in communication came when Samuel Morse invented telegraph in 1844. It played a significant role in colonisation of Western America in the 19th century. Invention of telephone in 1975 by Graham Bell and radio in 1894 by Marconi gave new direction to communication. The news was transmitted throughout the world with the help of radio and without using wire. Marconi sent the message across the Atlantic Ocean in 1901. After the fully developed television in 1945, transmission of picture becomes possible. Modern information technology has given many forms to communication. Now, the whole world has come closer together with the help of these communication aids such as cellular phone, E-mail, Fax, Internet, etc. Compared to means of transport, the means of communication have transformed the world into a **'global village'.**

Internet is today the world's most important means of communication. It has added new dimensions to international trade, banking, remote sensing and other aspects. Today, the Internet is used in a variety of fields like, education, trade, banking, management, industry, communication, health and surgery, scientific research, meteorology, administration and in hundreds of other fields. Internet is a huge reservoir of knowledge. According to one estimate, almost half of the world's population will be connected by internet by 2020.

Student Notes:

On the basis of scale and quality, the mode of communication can be divided into following categories: a) Personal Communication System and b) Mass Communication System.

Student Notes:

2.1. Personal Communication System

Personal Communication System includes use of letters, telephones, telegrams, fax, emails, internet etc. Among the above means, internet is the most widely used and most effective means of communication in urban areas. The network through internet and e-mail provides an efficient access to information at a comparatively low cost. It enables us with the basic facilities of direct communication. In the rural areas, telephones and letters play the role of bridging the people. With the development of technology, internet is expected to soon penetrate in the rural areas too.

2.2. Mass Communication System

Mass communication system includes usage of radio, television, cinema, satellite, newspaper, magazine and book, public meetings, seminars and conferences etc. It focuses on a single source transmitting information to a large group of receivers.

2.2.1. Radio

Radio broadcasting started in India in 1923 by the Radio Club of Bombay. Since then, it gained immense popularity and changed the socio-cultural life of people. Government brought Radio Broadcasting under its control in 1930 under the Indian Broadcasting System. It was changed to All India Radio in 1936 and to Akashwani in 1957. All India Radio broadcasts a variety of programmes related to information, education and entertainment. With the start of FM radio services in the country, radio has reached new standards in the country.

FM broadcasting began on 23 July 1977 in Chennai, then Madras, and was expanded during the 1990s. Times FM (now Radio Mirchi) began operations in 1993 in Ahmedabad. Until 1993, All India Radio or AIR, a government undertaking, was the only radio broadcaster in India. Indian policy currently states that these broadcasters are assessed a *One-Time Entry Fee (OTEF*), for the entire license period of 10 years. Under the Indian accounting system, this amount is amortised over the 10 year period at 10% per annum. Annual license fee for private players is either 4% of revenue share or 10% of Reserve Price, whichever is higher.

2.2.2. Television (T.V.)

Television broadcasting has emerged as the most effective audio-visual medium for disseminating information and educating masses. Initially, the T.V. services were limited *Television (T.V.)* Television broadcasting has emerged as the most effective audio-visual medium for disseminating information and educating masses. Initially, the T.V. services were limited only to the National Capital where it began in 1959. After 1972, several other centres became operational. In 1976, TV was delinked from All India Radio (AIR) and got a separate identity as Doordarshan (DD). After INSAT-IA (National Television-DD1) became operational, Common National Programmes (CNP) was started for the entire network and its services were extended to the backward and remote rural areas.

Asianet was the first private channel in India and also most popular in India. The central government launched a series of economic and social reforms in 1991 under Prime Minister Narasimha Rao. Under the new policies the government allowed private and foreign broadcasters to engage in limited operations in India. This process has been pursued consistently by all subsequent federal administrations. Foreign channels like CNN, STAR TV and private domestic channels such as Zee TV, ETV and Sun TV started satellite broadcasts. Starting with 41 sets in 1992 and one channel, by 1995, TV in India covered more than 70 million homes giving a viewing population of more than 400 million individuals through more than 100 channels.

There are *five basic types of television* in India: broadcast or "over-the-air" television, unencrypted satellite or "free-to-air", Direct-to-Home (DTH), cable television, and IPTV. Over-the-air and free-to-air TV is free with no monthly payments while Cable, DTH, and IPTV require a monthly payment that varies depending on how many channels a subscriber chooses to pay for. Channels are usually sold in groups or *a la carte*. All television service providers are required by law to provide a la carte selection of channels.

Student Notes:

2.2.3. Satellite Communication

The beginning of era of space in the world took place with the sending of artificial satellite-Sputnik in the space on 4th October, 1957. India has placed its own satellites in orbit for communication and surveying of national resources through remote sensing techniques. This has helped in giving telephone connections to each village. Now, a resident of a small village of India can talk via mobile or satellite phone from his home to his relative or friend sitting in anywhere in the world. Artificial satellites, now, are successfully deployed in the earth's orbit to connect even the remote corners of the globe with limited onsite verification. These have rendered the unit cost and time of communication invariant in terms of distance. This means it costs the same to communicate over 500 km as it does over 5,000 km via satellite

On the basis of configuration and purposes, satellite system in India can be grouped into two: *Indian National Satellite System* (**INSAT**) and *Indian Remote Sensing Satellite System* (**IRS**). The INSAT is a multipurpose satellite system for telecommunication, meteorological observation and for various other data and programmes. Established in 1983 with commissioning of INSAT-1B, it initiated a major revolution in India's communications sector and sustained the same later. INSAT space segment consists of 24 satellites out of which 10 are in service (INSAT-3A, INSAT-4B, INSAT-3C, INSAT-3E, KALPANA-1, INSAT-4A, INSAT-4CR,GSAT-8, GSAT-12 and GSAT-10).The system with a total of 168 transponders in the C, Extended C and Ku-bands provides services to telecommunications, television broadcasting, weather forecasting, disaster warning and Search and Rescue operations[2].

The IRS satellite system became operational with the launching of IRS-IA in March 1988 from Vaikanour in Russia. India has also developed her own Launching Vehicle PSLV (Polar Satellite Launch Vehicle). These satellites collect data in several spectral bands and transmit them to the ground stations for various uses. The National Remote Sensing Agency (NRSA) at Hyderabad provides facilities for acquisition of data and its processing. These are very useful in the management of natural resources.

3. International Trade

A transaction of any kind between two or more parties is called **trade.** It may takes place at two main levels - international and national. International trade is the exchange of goods and services among two or more countries of the world. There are various reasons although economic causes like availability and lower price are generally the main cause for international trade to take place.

The initial form of trade in primitive societies was the **barter system**, where direct exchange of goods took place. It was the system prevailing in the beginning and is considered the forerunner of modern trade. The barter system of exchange was a difficult and cumbersome process. One had not only to search for sellers and buyers but also carry a lot of weight amid any season of the year. There were other difficulties as well like making enquiries to find out what was required and what not. All this was overcome with *the* introduction of money. In the olden

[2] For complete list of Indian Communication Satellites, please visit http://en.wikipedia.org/wiki/List_of_Indian_satellites and http://www.isro.org/satellites/allsatellites.aspx

times, before paper and coin currency came into being, rare objects with very high intrinsic value served as money, like, flint stones, obsidian, *cowrie* shells, tiger's paws, whale's teeth, dogs teeth, skins, furs, cattle, rice, peppercorns, salt, small tools, copper, silver and gold.

The **Silk Route** was an excellent example of early organised international trade between distant lands. The 6,000 km long Silk Route linked Rome to China with other connecting points like India, Persia and Central Asia. The traders transported through this route Chinese silk, Roman wool and precious metals and many other high value commodities. After disintegration of Roman Empire, ascendancy of Europe began in 12th and 13th centuries. Trade flourished along with naval warfare. There was considerable rise in Asian and European trade which helped the discovery of new land including Americas.

Fifteenth century onwards, the European colonialism began and along with trade of exotic commodities, a new form of trade emerged which was called **slave trade.** The Portuguese, Dutch, Spaniards, and British captured African natives and forcefully transported them to the newly discovered Americas for their labour in the plantations.

After the Industrial Revolution the demand for raw materials like grains, meat and wool also expanded, but their monetary value declined in relation to the manufactured goods. The industrialised nations imported primary products as raw materials and exported the value added finished products back to the non-industrialised nations. In the later half of the nineteenth century, regions producing primary goods were no more important, and industrial nations became each other's principle customers.

During the World Wars I and II, there were concerns about security, taxes and quantitative restrictions imposed by many countries for the first time. As a result of these concerns organisations like General Agreement for Tariffs and Trade (GATT) later christened the **World Trade Organisation (WTO)** came into being. Their first task was to work towards reducing tariff, which many countries had imposed. International trade is the result of specialisation in production**.** It benefits the world economy if different countries practise specialisation and division of labour in the production of commodities or provision of services. Thus, international trade is based on the principle of comparative advantage, complimentarity and transferability of goods and services and in principle, should be mutually beneficial to the trading partners.

Trends in Growth in Trade Volumes

(per cent change)

			Projections	
	2011	2012	2013	2014
World trade volume (goods and services)	**5.9**	**2.8**	**3.8**	**5.5**
Imports				
Advanced economies	4.6	1.2	2.2	4.1
Emerging market & developing economies	8.4	6.1	6.5	7.8
Exports				
Advanced economies	5.6	2.1	2.8	4.5
Emerging market & developing economies	6.6	3.6	5.5	6.9

Source: International Monetary Fund (IMF), World Economic Outlook Update, January 2013.

3.1. Factors influencing International Trade

There are many factors which influence the international trade. Important among these are described below:

Inequality in Natural Resources: The distribution of natural resources is uneven in the world. Due to diversity in geological structure, climate, natural vegetation, soil, etc., different types of natural resources are found in different countries. Some countries possess some resources more than their requirement. These countries export their products to the countries which are either poor in reserves or do not have any reserve. Hence, inequality in natural resources is the main base of international trade. This inequality is on account of three important reasons:

Student Notes:

1) ***Geological structure:*** The diversity of relief is influenced by geological structure which is turn determines mineral resources base and diversity of agriculture and crops as well animals raised. For e.g. Lowlands have greater agricultural potential. Mountains attract tourists and promote tourism.
2) ***Mineral resources:*** They are unevenly distributed the world over. The availability of mineral resources provides the basis for industrial development.
3) ***Climate:*** It influences the type of flora and fauna that can survive in a given region. It also ensures diversity in the range of various products, e.g. wool production can take place in cold regions, bananas, rubber and cocoa can grow in tropical regions.

Population factors: Population size, distribution, diversity as well as people's tastes, likes and dislikes determine the type and volume of goods traded. Two important population factors are:

a) ***Cultural factors:*** Distinctive forms of art and craft develop in certain cultures which are valued the world over, e.g. China produces the finest porcelains and brocades. Carpets of Iran are famous while North African leather work and Indonesian batik cloth are prized handicrafts.
b) ***Size of population:*** Densely populated countries have large volume of internal trade but little external trade because most of the agricultural and industrial production is consumed in the local markets. Standard of living of the population determines the demand for better quality imported products because with low standard of living only a few people can afford to buy costly imported goods.

Stage of Economic Development: At different stages of economic development of countries, the nature of items traded undergoes changes. In agriculturally important countries, agro products are exchanged for manufactured goods whereas industrialised nations export machinery and finished products and import food grains and other raw materials.

Extent of foreign investment: Foreign investment can boost trade in developing countries which lack in capital required for the development of mining, oil drilling, heavy engineering, and lumbering and plantation agriculture. By developing such capital intensive industries in developing countries, the industrial nations ensure import of food stuffs, minerals and create markets for their finished products. This entire cycle steps up the volume of trade between nations.

Production more than Requirement: Some countries produce more than their requirement because of their favourable environment conditions, technological efficiency and skilled labour. Hence, these countries export their surplus products to other countries.

Shortage of Goods: No country is independent in all its requirement of goods. There exists shortage of some or the other goods. For example, Japan has technology for producing best quality steel and other means, but it lacks iron ore and coal. Hence, it overcomes the shortage of raw materials by importing them from India and Australia.

Development of Transport and Communication: Transport and communication are the main bases of international trade. Surface, water, air and pipeline transport are required for transferring goods from surplus producing countries to the countries of shortage.

Technological Inequality: Some countries have developed some specific type of technology which could not be developed by other countries. For example, United States of America and France have high level technology for building passenger aeroplanes. Other countries of the world purchase aeroplanes from these countries so as to meet their demand.

Trade Policies: Developing countries provide some concessions to exporters for boosting their export e.g. tax concessions, economic aid, etc. Such policies of the government aim to balance the trade in the country's favour or to enhance the foreign currency reserve, because export help to earn more foreign money. Many countries levy heavy taxes on goods of import so as to check their import and promote their local industries.

Economic Demand: Notwithstanding these bases, if there is no economic demand of goods, its international trade is impossible in such a situation. A country may have any quantity of surplus production but without demand, it cannot be goods of trade. When it becomes an economic demand, the country tries to procure it.

3.2. Components of International Trade

International trade has three very important aspects. These are volume, sectoral composition and direction of trade.

Volume of Trade: Volume of trade can be measured in three different ways: (a) Actual tonnage of goods traded; (b) Total volume and value of goods and; (c) Value on per capita basis. However, services traded cannot be measured in tonnage. Therefore, the **total value** of goods and services traded is considered to be the volume of trade.

Composition of Trade: The nature of goods and services imported and exported by countries have undergone changes during the last century. There has been a steady rise in the volume and prices of manufactured goods. On account of rapid growth of trade of manufactured goods there has been rapid growth of manufacturing industries. Thus, the prices of manufactured goods on account of large supplies are coming down. The trend of decrease in prices of manufactured goods is also on account of decrease in tariff barriers under the World Trade Organisation (WTO).

Direction of International Trade: Historically, the developing countries of the present used to export valuable goods and artefacts, etc. which were exported to European countries. During the nineteenth century there was a reversal in the direction of trade. European countries started exporting manufactured goods for exchange of foodstuffs and raw materials from their colonies. However, during the second half of the twentieth century, Europe lost its colonies while India, China and other developing countries started competing with developed countries. The nature of the goods traded has also changed.

3.3. Types of International Trade

International trade may be categorised into two types: (a) **Bilateral trade**: Bilateral trade is done by two countries with each other. They enter into agreement to trade specified commodities amongst them. For example, country A may agree to trade some raw material with agreement to purchase some other specified item to country B or vice versa. (b) **Multi-lateral trade**: As the term suggests multi-lateral trade is conducted with many trading countries. The same country can trade with a number of other countries. The country may also grant the status of the "*Most Favoured Nation*" (MFN) on some of the trading partners.

3.4. International Pattern of Trade

1) On account of globalisation of agricultural and industrial products, the international trade become highly complex.
2) Fast Growth Rate: The volume of trade is growing very fast.
3) The rate of growth of export trade is almost double that of production rate.
4) The rate of growth of export trade is many times more than the rate of growth of world population.
5) About 25 per cent of world production has now entered international trade.

3.5. Regional Trade Blocs and World Trade Organisation (WTO)

In1948, to liberalise the world from high customs tariffs and various other types of restrictions, General Agreement for Tariffs and Trade (GATT) was formed by some countries. In 1994, it was decided by the member countries to set up a permanent institution for looking after the promotion of free and fair trade amongst nation and the GATT was transformed into the World Trade Organisation from 1st January 1995.

Student Notes:

WTO is the only international organisation dealing with the global rules of trade between nations. It sets the rules for the global trading system and resolves disputes between its member nations. WTO also covers trade in services, such as telecommunication and banking, and others issues such as intellectual rights.

Regional Trade Blocs have come up in order to encourage trade between countries with geographical proximity, similarity and complementarities in trading items and to curb restrictions on trade of the developing world. Today, 120 regional trade blocs generate 52 per cent of the world trade. These trading blocs developed as a response to the failure of the global organisations to speed up intra-regional trade. Though, these regional blocs remove trade tariffs within the member nations and encourage free trade, in the future it could get increasingly difficult for free trade to take place between different trading blocs.

Major Regional Trade Blocs

Regional Blocs	Head Quarters	Member Nations	Origin	Commodities	Other areas of co-operation
ASEAN (Association of South East Asian Nations)	Jakarta, Indonesia	Brunei, Indonesia, Malaysia, Singapore, Thailand, Vietnam, Philippines, Myanmar, Cambodia, Laos	Aug, 1967	Agro products, rubber, palm oil, rice, copra, coffee, minerals – copper, coal, nickel and tungsten; Energy – petroleum and natural gas and Software products	Accelerate economic growth, Cultural development, Peace and regional stability
CIS (Commonwealth of Independent States)	Minsk, Belarus	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.	-	Crude oil, natural gas, gold, cotton, fibre, aluminium	Integration and cooperation on matters of economics, defence and foreign policy
EU (European Union)	Brussels, Belgium	Austria, Belgium, Denmark, France, Finland, Ireland, Italy, the Netherlands, Luxemburg, Portugal, Spain, Sweden and U.K.	EEC - March 1957 EU - Feb. 1992	Agro products, minerals, chemicals, wood, paper, transport vehicles, optical instruments, clocks - works of art, antiques	Single market with single currency
LAIA (Latin American Integration Association)	Montevideo, Uruguay	Argentina, Bolivia, Brazil, Columbia, Ecuador, Mexico, Paraguay,	1960	-	-

		Peru, Uruguay and Venezuela			
NAFTA (North American Free Trade Association)		U.S.A., Canada and Mexico	1994	Agro products, motor vehicles, automotive parts, computers, textiles	-
OPEC (Organisation of Petroleum Exporting Countries)	Vienna, Austria	Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, U.A.E. and Venezuela	1949	Crude petroleum	Coordinate and unify petroleum policies
SAFTA (South Asian Free Trade Agreement)		Bangladesh, Maldives, Bhutan, Nepal, India, Pakistan and Sri Lanka	Jan-2006	-	Reduce tariffs on interregional trade

3.6. Balance of Trade

Balance of Trade includes all transactions in goods and services including international aid and investments appearing in the current account of a country. By balances of trade we are able to compare the import-export of goods and *services* into a country. When the value of exported goods of a country exceeds the value of imported goods, it is called *positive balance of trade.* Contrary to this, if the value of imported goods exceeds the value of exported goods, it is called *negative trade balance.*

Global Top 10 Trading Countries[3]

Rank	Exporter	Value	Share	Annual Percentage Change	Rank	Importers	Value	Share	Annual Percentage Change
1	China	2049	11.1	8	1	USA	2336	12.6	3
2	USA	1546	8.4	4	2	China	1818	9.8	4
3	Germany	1407	7.6	-5	3	Germany	1167	6.3	-7
4	Japan	799	4.3	-3	4	Japan	886	4.8	4
5	Netherland	656	3.6	-2	5	UK	690	3.7	2
6	France	569	3.1	-5	6	France	674	3.6	-6
7	S.Korea	548	3.0	-1	7	Netherland	591	3.2	-1
8	Russia	528	2.9	1	8	Hong Kong	553	3.0	8
9	Italy	501	2.7	-4	9	S. Korea	520	2.8	-1
10	Hong Kong	493	2.7	8	10	India	490	2.6	5

Values in Billion Dollar and Percentage

3.7. Concerns Related to International Trade

International trade is mutually beneficial to nations provided the following conditions are met:

1) It leads to domestic competitiveness and enhances regional specialisation.

[3] Leading exporters and importers in World merchandise trade, 2012

2) Increases sales and organisations *achieve* higher level of production
3) *Improves* standard of living both through income and employment opportunities.
4) It makes goods and *services* available globally.
5) Through enhancing sales potential there is equalisation of prices and wages.
6) International trade technology leads to diffusion of knowledge and culture.

Student Notes:

3.8. Limitations of International Trade

The limitations and demerits of the international trade can be studied as follows:

1) It creates a scenario dependence on other countries.
2) More inequalities and *uneven* levels of development are created.
3) International trade promoted exploitation, and commercial rivalry leading to wars
4) Global trade affects many aspects of life.
5) Through rapid changes in consumption and production pattern, international trade impacts everything from the environment to health and well-being of the people around the world.
6) International trade works to economy's and a company's advantage and leads to more, production and the use of natural resources. It is detrimental to resources' consumption.
7) Resources get used up at a faster rate than they can be replenished.
8) Through increased shipping on account of increase in tourism and trade marine life depletes fast.
9) As a result of exploitation of natural resources forests are being cut down.
10) The *river* basins and underground water are used sold off to private drinking water companies.
11) There is more pollution on account of expanding business especially by multinational corporations trading in oil, gas mining, pharmaceuticals and agri-business.
12) The norms of sustainable development are neglected as there is more profit maximisation.

3.9. India's Foreign Trade

After moderating in the two years following the global economic crisis, world trade in both goods and services in the financial year 2013-14 reached and surpassed pre-crisis levels in 2011. However, the deceleration in world growth and trade in 2012 and forecast of only a gradual upturn in global growth by international institutions portend a weak and slow recovery for world trade.

India's merchandise trade increased exponentially in the 2000s decade from US$ 95.1 billion in 2000-1 to US$ 620.9 billion in 2010-11 and further to US$ 793.8 billion in 2011-12. India's share in

Student Notes:

Commodity Composition of India's Imports

Commodity Group	Percentage share					CAGR	Growth rate[a]			
	2000-01	2010-11	2011-12	2011-12 (Apr.-Nov.)	2012-13 (Apr.-Nov.)	2000-01 to 2009-10	2010-11	2011-12	2011-12 (Apr.-Nov.)	2012-13 (Apr.-Nov.)
I. Food and allied products, of which	**3.3**	**2.9**	**3.1**	**3.1**	**3.5**	**22.7**	**2.2**	**44.4**	**38.0**	**11.6**
1. Cereals	0.0	0.0	0.0	0.0	0.0	24.3	15.8	-34.2	-46.6	6.8
2. Pulses	0.2	0.4	0.4	0.4	0.4	38.3	-23.1	27.2	11.3	9.2
3. Edible oils	2.6	1.8	2.1	2.1	2.5	17.2	19.0	57.7	55.3	18.0
II. Fuel, of which	**33.5**	**30.9**	**37.4**	**34.3**	**38.0**	**21.0**	**22.4**	**59.7**	**52.3**	**9.8**
4. POL	31.3	28.7	31.7	30.7	34.6	21.0	21.6	46.2	50.6	11.7
III. Fertilizers	**1.3**	**1.9**	**2.4**	**2.3**	**2.2**	**29.0**	**4.8**	**72.1**	**32.2**	**-6.8**
IV. Capital goods, of which	**10.5**	**13.6**	**14.1**	**12.6**	**11.9**	**26.1**	**19.2**	**36.9**	**25.6**	**-6.5**
5. Machinery except electrical & machine tool	5.9	7.0	7.2	6.7	6.3	24.4	24.0	35.8	28.2	-5.8
6. Electrical machinery	1.0	1.0	1.0	1.0	0.9	22.7	25.1	33.1	26.6	-5.5
7. Transport equipment	1.4	3.1	3.0	2.5	2.3	36.4	-0.9	31.8	13.1	-8.3
V. Others, of which	**52.5**	**49.6**	**49.0**	**47.6**	**44.3**	**19.3**	**43.2**	**30.8**	**29.6**	**-7.6**
8. Chemicals	5.9	5.2	5.1	5.0	5.1	19.5	29.6	31.8	24.3	1.1
9. Pearls, precious, semi-precious stones	9.7	9.3	6.1	6.1	4.1	14.0	116.9	-13.3	4.3	-32.3
10. Gold & silver	9.3	11.5	12.6	13.0	10.5	23.0	43.0	44.5	59.2	-20.4
11.Electronic goods	7.0	7.1	7.1	7.0	6.5	21.6	28.4	31.7	22.2	-7.7
Total imports	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**21.5**	**28.2**	**32.3**	**36.2**	**-0.8**

Source: Computed from DGCI&S data. [a] Growth rate in US dollar terms

global exports and imports also increased from 0.7 per cent and 0.8 per cent respectively in 2000 to 1.7 per cent and 2.5 per cent in 2011 as per the WTO. Bolstered by the measures taken by the government to help exports in the aftermath of the world recession of 2008 and the low base effect, India's export growth in 2010-11 reached an all time high since Independence of 40.5 per cent. Though it decelerated in 2011-12 to 21.3 per cent, it was still above 20 per cent and higher than the compound annual growth rate (CAGR) of 20.3 per cent for the period 2004-5 to 2011-12.

India faced serious food shortage during 1950s and 1960s. The major item of import at that time was food grain, capital goods, machinery and equipments. The balance of payment was adverse as imports were more than export in spite of all the efforts of import substitution. After 1970s, food grain import was discontinued due to the success of green revolution but the energy crisis of 1973 pushed the prices of petroleum, and import budget was also pushed up. Food grain import was replaced by fertilisers and petroleum. Machine and equipment, special steel, edible oil and chemicals largely make the import basket.

The export-import ratio highlights the direction of trade between the two countries. Most of the countries want to maintain this ratio greater than one in order to boost their exports and reduce dependency on imports. A look at the trade share and export-import ratio of India with its major trading partners is as follows:

Student Notes:

Sl. No.	Country	Share in total trade					Export/Import ratio[a]				
		2009-10	2010-11	2011-12	2011-12 (Apr-Nov.)	2012-13 (Apr-Nov.)	2009-10	2010-11	2011-12	2011-12 (Apr-Nov.)	2012-13 (Apr-Nov.)
1	China	9.09	9.50	9.52	9.62	8.95	0.38	0.36	0.31	0.29	0.23
2	U A E	9.31	10.72	9.03	8.99	9.74	1.23	1.03	1.00	0.98	0.92
3	U S A	7.82	7.30	7.46	7.29	8.23	1.15	1.26	1.42	1.42	1.51
4	Saudi Arabia	4.50	4.04	4.63	4.57	5.43	0.23	0.23	0.18	0.17	0.28
5	Switzerland	3.27	4.11	4.22	4.30	3.50	0.04	0.03	0.03	0.03	0.04
6	Singapore	3.01	2.73	3.21	3.30	2.53	1.18	1.38	1.96	1.85	1.75
7	Germany	3.37	3.00	3.05	3.02	2.75	0.52	0.57	0.49	0.50	0.48
8	Hong Kong	2.70	3.18	2.97	3.09	2.53	1.67	1.10	1.21	1.09	1.51
9	Indonesia	2.51	2.52	2.68	2.69	2.50	0.35	0.57	0.46	0.38	0.34
10	Iraq	1.61	1.56	2.48	2.49	2.73	0.07	0.08	0.04	0.03	0.07
11	Japan	2.22	2.21	2.32	2.19	2.29	0.54	0.59	0.52	0.46	0.47
12	Belgium	2.09	2.32	2.22	2.21	1.91	0.62	0.67	0.69	0.71	0.52
13	Kuwait	1.93	1.96	2.21	2.02	2.38	0.09	0.18	0.07	0.08	0.06
14	Korea RP	2.57	2.29	2.20	2.20	2.30	0.40	0.36	0.33	0.35	0.29
15	Nigeria	1.86	2.08	2.19	2.19	2.14	0.19	0.19	0.18	0.18	0.20
	Total of 15 countries	57.84	59.50	60.40	60.16	59.91	0.56	0.55	0.51	0.49	0.50
	India's trade	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**0.62**	**0.68**	**0.62**	**0.62**	**0.58**

Source **: Computed from DGCI&S data.**

Note **: [a] A coefficient of export and import ratio between 0 and 1 implies that India's imports are greater than exports and if the coefficient is greater than one, India exports more than what it imports.**

3.10. Challenges in International Trade for India

The challenges for India on the trade front are many. While India has successfully diversified its export basket, more needs to be done on the product diversification front. It also has to reposition itself in its traditional areas of strength like textiles and leather & leather manufactures where it has lost considerable ground, while at the same time making forays into new areas. With multilateral trade negotiations stalled, and RTAs on the rise, India also has to follow a strategic regional trading policy focusing on the potential technology-intensive items in the more important RTAs. Though geopolitical considerations are important, India may have to bargain more in its regional trade negotiations, particularly in cases where livelihood concerns of large pockets of the population are involved, There is also need to address the inverted duty structure in sectors like electronics, textiles, and chemicals and the artificial inverted duty structure caused by some FTAs/RTAs. On the services front, a gold mine of opportunity in sectors like tourism including health tourism is waiting to be tapped.

Thus there are many micro, port-specific and sector-specific issues that need urgent attention. These are related to infrastructure, trade facilitation, tax and tariffs, and credit, and can realistically be addressed in the short and medium term. Addressing these issues, as is currently being done by the government, can exponentially promote India's export growth.

4. UPSC Prelim Previous Year Question

1. Consider the following pairs:

National Highway		**Cities connected**
1. NH4	:	Chennai and Hyderabad
2. NH6	:	Mumbai and Kolkata
3. NH15	:	Ahmedabad and Jodhpur

Which of the above pairs is/are correctly matched ? (2014)

(a) 1 and 2 only (b) 3 only

(c) 1, 2 and 3 (d) None

Student Notes:

2. Recently, which of the following States has explored the possibility of constructing an artificial inland port to be connected to sea by a long navigational channel? (2016)
(a) Andhra Pradesh (b) Chhattisgarh
(c) Karnataka (d) Rajasthan

3. Project Loon', sometimes seen in the news, is related to (2016)
(a) waste management technology (b) wireless communication technology
(c) solar power production technology (d) water conservation technology

4. With reference to India's satellite launch vehicles, consider the following statements:
1. PSLVs launch the satellite useful for Earth resources monitoring whereas GSLVs are designed mainly to launch communication satellites.
2. Satellites launched by PSLV appear to remain permanently fixed in the same position in the sky, as viewed from a particular location in Earth.
3. GSLV Mk III is a four-staged launch vehicle with the first and third stages using solid rocket motors; and the second and fourth stages using liquid rocket engines.

Which of the statements given above is/are correct? (2018)
(a) 1 only (b) 2 and 3
(c) 1 and 2 (d) 3 only

5. In which of the following activities are Indian Remote Sensing (IRS) satellites used?
1. Assessment of crop productivity
2. Locating groundwater resources
3. Mineral exploration
4. Telecommunications
5. Traffic studies

Select the correct answer using the code given below. (2018)
(a) 1, 2 and 3 only (b) 4 and 5 only
(c) 1 and 2 only (d) 1, 2, 3, 4 and 5

6. With reference to the international trade of India at present, which of the following statements is/are correct?
1. India's merchandise exports are less than its merchandise imports.
2. India's imports of iron and steel, chemicals, fertilisers and machinery have decreased in recent years.
3. India's exports of services are more than its imports of services.
4. India suffers from an overall trade/current account deficit.

Select the correct answer using the code given below: (2020)
(a) 1 and 2 only (b) 2 and 4 only
(c) 3 only (d) 1, 3 and 4 only

5. UPSC Mains Previous Year Question

1. National Urban Transport Policy emphasises on 'moving people' instead of 'moving vehicles'. Discuss critically the success of the various strategies of the Government in this regard. (2014)

2. Examine the developments of Airports in India through Joint Ventures under Public-Private Partnership (PPP) model. What are the challenges faced by the authorities in this regard. (2017)

3. How would the recent phenomena of protectionism and currency manipulations in world trade affect macroeconomic stability of India? (2018)

6. Vision IAS Previous Years Mains Questions

Student Notes:

1. Highlight the challenges faced by the civil aviation sector in India. What steps have been taken by the government to address these challenges?

Approach:

- Give a brief introduction about the civil aviation sector in India.
- Highlight the challenges faced by the civil aviation sector.
- State the steps taken by the government to address these challenges.
- Conclude with a few additional measures required for the growth of aviation sector.

Answer:

India is the third largest aviation market in the world, with approximately 16% air passenger traffic growth over the past decade. However, the aviation sector still remains a risk laden business with huge capital expenditure requirement and low profit margins.

The challenges faced by the civil aviation sector are:

- **Inadequate infrastructure:** Due to the rapid expansion of India's civil aviation sector, airspace, parking bays and runway slots will become increasingly scarce over the next few years. For example, airports in Mumbai and Chennai are already close to saturation due to unavailability of land.
- **Lack of skilled workers**: To keep up with expansion, about 0.25 million persons will have to be skilled over the next 10 years. However, training is constrained by shortage of instructors, lack of assured supply of aviation gasoline used in training aircrafts etc.
- **Aviation safety**: Various international authorities like the International Civil Aviation Organization have raised concerns on the aviation safety measures followed in India.
- **Rupee fluctuation**: Indian rupee's depreciation adversely affects airline carriers. About 25-30% of their costs such as aircraft lease rents, maintenance costs to ground handling, parking charges abroad etc. are dollar denominated.
- **High taxes on aviation turbine fuel (ATF):** High ATF costs coupled with regional disparities in its price increase the expenditure of the carriers. Further, expensive ATF makes it difficult to compete with aviation hubs like Dubai and Singapore, which charge far lower rates.
- **Low profits**: High costs owing to GST in the range of 5-28% on aircraft engines and spare parts, intense domestic competition and price sensitivity of passengers make it difficult to increase profit margins.
- **Low domestic air cargo growth**: International cargo, comprising 60% of the total air cargo handled in the country, logged a growth of 15.6%, while domestic cargo grew by only 8%.

Various steps taken by the government in this regard include:

- **National Air Cargo Policy, 2019**: It envisages making Indian air cargo and logistics the most efficient, seamless and cost effective globally by the end of the next decade.
- **Encouraging private sector participation:** Foreign investment up to 49 per cent has been allowed under automatic route in scheduled air transport service, regional air transport service and domestic scheduled passenger airline. Further, the government has also approved management of several airports under PPP.
- **Regional connectivity**: Through the UDAN scheme, the government has added numerous small airports to the Indian aviation circuit, propelling the sector's growth construction of Sikkim's first airport etc.

Student Notes:

- **Domestic manufacturing**: The government is working on a blueprint to promote domestic manufacturing of aircrafts and aircraft financing.
- **Improvements in service and hospitality**: Through Project DISHA (Driving Improvements in Service and Hospitality at Airports), the Airport Authority of India plans to upgrade the existing airports in order to enhance operational efficiency.
- **Safety measures:** It includes issuing of detailed instructions to the airports by the Bureau of Civil Aviation Security to curb movement of unauthorized arms, contraband goods and conducting surprise inspections etc.

Alongwith these steps, the government should focus on increasing financial investment in the sector, encouraging domestic airlines to maintain debts in manageable proportions and promote fair competition between them to meet the full potential of the sector.

2. Recognizing the significance of a reliable and swift road network in the country, mention the major initiatives taken by the government to improve India's road infrastructure.

Approach:

- Briefly highlight the significance of reliable and swift road network in the country.
- State the major initiatives taken by government to improve India's road infrastructure.
- Conclude on the basis of the above points.

Answer:

India has the world's second-biggest road network, which sprawls 5.4 million km throughout the country. A reliable and swift road network is of vital significance in India due to the following reasons:

- The road network **transports 64.5 percent of all goods** in the country **and 90 percent of total** passenger traffic as **multi modal mix of transportation** is lacking in terms of development and infrastructure.
- Roads are vital to India's developmental agenda for they ensure hinterland connectivity etc.
- Road infrastructure affects the **flexibility and mobility of the workforce**, which is reflected in the employment level.
- The degree to which road infrastructure is developed has an **impact on other areas** such as development of tourism, influx of foreign investments, regional development, etc.
- Road transport is significant in the international context in terms of **foreign trade and cooperation** in different areas.
- It is important to **connect the hinterland with the ports** as well to ensure that a programme like Make in India takes off at a rapid pace. It will also help in **increasing export competitiveness** of Indian goods.

The major initiatives taken by the government to improve India's road infrastructure include:

- **National Highway Development Projects:** Some of the key projects are the Golden Quadrilateral project, the North-South & East-West Corridors, road connectivity of major ports of the country to the national highways etc.
- **Bharatmala Pariyojana:** It envisages new initiatives like development of border and international connectivity roads, coastal & port connectivity roads and improvements in the efficiency of National Corridors and Economic Corridors.

Student Notes:

- **Development of roads in challenging terrain:** The Ministry of Road Transport and Highways **(**MORTH) plans to upgrade roads in the North-Eastern region to improve road connectivity in all district headquarters. The government has also approved a 'Road Requirement Plan' for the development of national and state highways in the remote districts of Central/Eastern India.
- **Hybrid Annuity Model:** A new hybrid annuity model has been developed, in which the government contributes 40 percent of a project cost in the first five years, while private players cover the remaining 60 percent after the completion of the project.
- **Foreign Direct Investment**: In a bid to facilitate private funding, 100 percent foreign direct investment is permitted in the road sector.
- **National Highways and Infrastructure Development Corporation Ltd.:** It speeds up road construction in strategic areas along the international border and the North-Eastern region.
- **Logistic Efficiency Enhancement Programme (LEEP):** It aims at enhancing freight movement through improvement in cost, time, tracking and transferability of consignments through infrastructure, procedural and Information Technology interventions.
- **Bhoomi Rashi Portal**: The Ministry Of Road Transport and Highways launched the portal to digitize and automate the process of land acquisition to expand road infrastructure.

Despite the initiatives, several constraints remain such as overstrained national and state highways, lack of funds, inadequate maintenance of existing infrastructure, concerns regarding road accidents and safety etc. Thus, the aim should be to further enhance connectivity by expanding the road network, improving road maintenance and safety, and ensuring last mile connectivity in the rural areas, among others.

3. What is Intelligent Transportation System (ITS)? Explaining the need of ITS in India, identify the challenges in deploying it.

Approach:

- Explain Intelligent Transportation Systems (ITS) and how it improves the quality of life.
- Highlight the need for deploying ITS.
- Issues being faced in deploying ITS in developing countries like India.
- Suggest a way forward in the conclusion.

Answer:

Intelligent Transport Systems (ITS) provide transport solutions by utilizing state-of-the-art information and telecommunications technologies. It applies sensing, analysis, control and communications technologies to ground transportation. It is an integrated system of people, roads and vehicles, designed to significantly contribute to improve road safety, efficiency and comfort as well as environmental conservation through realization of smoother traffic by relieving traffic congestion.

The rapidly increasing vehicle population in India, spurred by population boom and economic upturn lays a critical burden on traffic management in urban areas. Thus, there is a need to deploy ITS in order to:

- **Improve road safety and security** for all users. For ex- Video Traffic Management using CCTV to provide information for traffic and incident management
- **Address increasing congestion**, which is raising travel times and industry costs. For ex-Traffic Signal Priority for Buses and Automatic Vehicle Tracking System focuses on analysis of data for adjusting transit schedules

Student Notes:

- **Make available real-time information** to commuters and agencies, helping in better travel planning and traffic management, saving man-hours and energy, thus providing a sustainable solution
- **Enhance the attractiveness of public transport**
- **Reduce the environmental impacts of transport**
- **Improve the competitiveness and performance** of freight logistics systems

Issues being faced in deploying ITS in developing countries like India are following:

- **Technology**: electronic equipment such as sensors, detectors and communication devices etc. need to be developed; also developing a comprehensive data collection system would be a challenge..
- **Modelling of Indian traffic** – a proper understanding of the traffic system for building a reliable ITS systems.
- **Supply Chain**: seamless interconnectivity of the various branches of the transportation sector for effective, efficient and secure movement of goods and services.
- **Energy and Sustainability**: It should closely work with the energy sector in the promotion of fuel efficient transport policies and practices.
- **Human Capital Development**: a work force that can develop, manage and safely implement existing and emerging technologies
- **Standards:** establishing ITS standards applicable throughout the urban and rural sections of India
- **Managing heterogeneity:** designing an ITS that encompasses the heterogeneous vehicle population
- **Collaboration:** Setting up active interaction between academia, industries and governmental agencies
- **Regulation:** setting up rules and regulations of traffic that will aid in ITS implementation

While India has already made a foray into intelligent transport systems in organizing traffic, more extensive and urgent integration of advanced technology and concepts into mainstream traffic management is the need of the hour. This requires establishing aggressive, yet achievable, near and long-term performance goals for transportation systems.

4. Identify the challenges faced by the railways in India. In this context, also discuss the ways in which the Railways can be transformed into an efficient public service provider as well as commercially viable entity.

Approach:

- Briefly introduce railways by mentioning its importance.
- Mention various challenges being faced by Railways.
- Mentions suggestions to revive the Railways.
- Conclude on the basis of above points.

Answer:

Indian Railways (IR) is the largest passenger and fourth largest freight transporting railway system globally, however, it has been facing various challenges inhibiting its efficient functioning such as:

- **Lack of commercially driven policies**: Railway is suffering from bad financial health due to low passenger fares, commercially unviable new trains routes and skewed freight fare pricing for cross subsidization. It has a high operating ratio of 98.4% i.e.

railways spends INR 98.4 to earn INR 100 (2017-18). The issue is compounded by under-investment, which has crippled operations and hampered capacity augmentation.

- **Congested Networks:** Over-stretched infrastructure with 60 percent plus routes being more than 100 percent utilized, leading to reduction in average speed of passenger and freight trains. Further, the same network is shared by both passenger and freight trains which limits the capacity of freight traffic.
- **Organizational structure**: Characterized by delays in decision making and long project approval durations.
- **Safety and poor quality of service delivery:** There have been a number of accidents and safety issues in the Indian Railways in recent years. Poor cleanliness of trains and stations, delays in train departures/arrivals, quality of food and difficulties in booking tickets are key issues.
- **Inefficiency of terminals**: Poor terminal facilities lengthen loading and unloading times. 80% of railway loads come from terminals.

Various committees like Bibek Debroy, Anil Kakodkar and Rakesh Mohan have given recommendations to tackle these challenges and make Indian Railways efficient and commercially viable.

Following initiatives can be undertaken to make Railways an efficient public service provider:

- **Revamping organizational structure** to facilitate decentralized decision-making to zones/divisions along with change in composition of the Railway Board need to be taken.
- **Fast tracking** Dedicated Freight Corridors (DFCs) project and other projects aimed at enhancing signaling and build capacity need to be completed to decongest the railway network and increase the speeds of trains.
- **More private trains** on the lines of **Tejas Express** should be introduced to improve overall quality of service.
- **Universalizing the use of LHB:** Old coaches of railways should be replaced with **LHB (linke-Hoffman-Busch)** coaches for its improved travel safety and efficiency.
- **Improving the punctuality** of trains by developing an integrated block management system. Ensuring automatic information to passengers about delay and developing semi high-speed trains to enhance connectivity. For e.g. Regional Rapid Transit System (RRTS).

Steps that can be taken to increase commercial viability:

- **Rationalization of freight rates** should be undertaken to make them more viable and competitive.
- Raise **additional revenues** from railway stations by investing in facilities, modernizing stations and contracting space to private players through smart advertisement space-selling like Delhi Metro, selling surplus and potentially unusable land; by developing commercial zones/shopping malls near the station area etc.
- **Separation of core functions** of running trains from non-core functions like schools and hospitals should be done at all the levels.

In addition to this, there is a need to expedite the process of establishing the **Rail Development Authority (RDA)** which must advise/make informed decisions on an integrated, transparent and dynamic pricing mechanism to determine rail fares and rebalance the passenger and freight categories to improve efficiency and rebalance the modal mix of goods transport.

Student Notes:

5. A developed Inland Waterway Transport (IWT) will not only augment the overall transport capacity of the country, but also help correct the multi-modal transport mix. Discuss.

Approach:

- Briefly discuss about the potential of IWT.
- Highlight the benefits of Inland waterways in terms of augmenting capacity.
- Discuss about the imbalance in modal mix of transport sector.
- Write some steps being taken in this regard.

Answer:

At present, India has about 14,500 km of navigable waterways comprising of different river systems, canals, backwaters, creeks and tidal inlets across different physiographic regions. Despite their various economic and environmental advantages, the logistic share of waterways in India remains only at about 1.5%, as compared to China having 8.7% share.

Developing Inland Waterway Transport (IWT) will **augment the overall transport capacity** in following ways:

- **Carrying more freight volumes**: It can augment cargo transportation manifold. For eg: Maharashtra Waterways alone transported more than 33.29 MMT in 2016- 17. Similarly, fly ash to the tune of more than 1000 tonnes was transported from Bihar to Assam through waterway.
- **Enhancing connectivity through new routes:** For eg**:** NW-1 (being developed under Jal Marg Vikas Project) along with the proposed Eastern Dedicated Freight Corridor and NH-19 will function as a link between South Asian and South-East Asian countries and New Delhi.
- **Enable efficient bulk cargo movement:** Adopting state of the art vessel designs would enable movement of bulk cargo carriers at one go, thereby removing almost 150 truckloads of pressure from road or one full rail rake.
  IWTs would also help **correct the multi-modal transport mix.** It will form part of a larger multi-modal transport network having linkages with railways, roadways, coastal shipping and airways. Being fuel efficient and environment friendly, it can supplement and complement the over-burdened rail and congested roads network, which cater to lion's share of passenger and freight traffic in India.

As per the World Bank, the cost of transport of one tonne of freight over a km by road is Rs 2.28, by rail Rs 1.41 and Rs 1.19 for waterways. Hence, besides correcting modal share, IWT would provide faster alternate transportation facility at comparatively lower costs. Recognizing this potential, government launched **Sagarmala programme** which aims to double the share of domestic waterways in the modal mix in the next ten years.

However, developing IWT alone is not sufficient. Other measures also need to be undertaken to promote it, such as financial incentives for transportation through IWT, higher road taxes on transportation of coal and inflammable material over longer distances, enhancing terminal facilities, promoting industrial corridors along riverbanks etc.

Student Notes:

6. Highlight the factors that constrain the growth of logistics sector in India. What can be done to remove these constraints?

Approach:

- Give a brief introduction about current status of logistics sector in India.
- Highlight the major challenges being faced by this sector.
- Discuss the various steps required to remove these challenges.
- Conclude on the basis of the above points.

Answer:

According to the World Bank's 2018 Logistics Performance Index, India jumped to 44th rank in 2018 from 54th rank in 2014 in terms of overall logistics performance.However, the logistics costs in India are still very high (14% of the GDP) as compared to other countries like USA (9%), Japan (11%) leading to poor manufacturing competitiveness.

There are **factors constraining** realization of its full potential:

- **Cost of logistics:** It remains huge due to challenges in accessing finance, underdeveloped infrastructure, poor connectivity and an unfavorable modal mix.
- **Lack of coordination among multiple stakeholders:** Transport, warehousing, freight forwarding and value added logistics falls under different segments of regulatory oversight adding complexity to the system.
- **Inadequate warehousing capacity:** Handling and warehousing facilities are still un-mechanized with manual loading-unloading and handling in the case of many commodities. Also there is low value addition in the warehouse sector.
- **Challenges in seamless movement of goods:** In addition to lack of interoperable technology, the movement of goods across modes suffers from the absence of last mile connectivity and infrastructure. For example, poor road and rail connectivity to most non-major ports leads to delays in travel time.
- **Limited Competition and underutilized capacity:** Disproportionate benefits to the public sector leads to unfair competition and affects utilization of the full capacity of private players such as container train operators or foreign vessel owners.
- **Higher border compliance and document processing time:** India's average border compliance time (including customs regulations and mandatory inspections) and document processing time (including documentary compliance for various agencies including regulators) are much higher.

According to the Niti Aayog, a 10 per cent decrease in indirect logistics cost has the potential to increase exports by 5-8 per cent**. In this context, following measures are required to remove the constraints of logistic sectors:**

- Rationalize tariffs and determine prices in an efficient manner across different modes. This will help in keeping a check at an increasing cost of logistics.
- Create an overarching body or institute that will maintain a repository of all transport data and provide a framework for moving towards an integrated transport model. This will help in bringing coordination among multiple stakeholders**.**
- Enhance the efficiency of warehouses and their operations through capacity building.
- Enhance technology by shifting towards international standards for transport equipment and software.
- Provide level playing field to private players at CONCOR terminals and opening up of port terminals to them.
- Infrastructure development to reduce the freight time and create last mile connectivity.

Student Notes:

In recent times, the government has taken various initiatives like giving infrastructure status to the sector, implementation of GST, relaxing FDI norms, funding for building the infrastructure etc. The recent plan to unveil National Logistic Policy would also provide the required boost to the sector.

7. Discuss the potential of multimodal transport in transforming India's transportation and logistics sector. Mention the measures taken by the government in this regard.

Approach:

- Briefly explain what you understand by Multimodal transport and discuss its potential in transforming India's transportation and logistics sectors.
- State the initiatives taken by the government with regard to Multimodal transport.
- Conclude appropriately.

Answer:

Multimodal transport is the combination of different modes of transport (road, rail, air, water, etc.), in order to facilitate movement of cargo and people in a faster and more efficient way.

Potential of multimodal transport in transforming India's transportation and logistics sector:

- **Sustainable economic growth:** Efficient multimodal logistics infrastructure can help catalyse economic growth in India by reducing transportation costs, increasing efficiency in service delivery and reducing the overall environmental impact of logistics.
- **Minimizes time loss at trans-shipment points:** It can potentially reduce transit times by 40-50% by acting as 'chain that connects different links or modes of transport'.
- **Reduces the burden of multiple documentation and formalities:** Since it relies on a single document related to movement of logistics throughout the country, thus it can help reduce documentation and verification time connected with each segment of the transport chain.
- **Improves export potential:** Reduced transportation and logistics costs will reduce the export cost and improve their competitive position in the international market. As per the Economic Survey-2017-18, improving the logistics sector will facilitate 10% decrease in indirect costs leading to the growth of 5 to 8% in exports.
- **Less congestion and cost savings:** Creation of a transportation grid by connecting railways, highways, inland waterways and airports will help to avoid over-burdening of any particular mode of transportation and thus saving space and costs associated with congestion, fuel cost, etc.

India has witnessed growth in multimodal transport in the recent years and the sector is still evolving. But still the logistics cost is around 14% of India's GDP, which needs to be reduced significantly through various measures. Realising its potential, the government has taken following initiatives in this regard:

- **Legislation and policy:** Government enacted **Multimodal Transportation of Goods Act, 1993** with the purpose of streamlining logistics and regulating the Multimodal Transport Operator (MTO). Further, a **National Logistics Policy** is being formulated to ensure seamless, multi modal growth of an efficient logistics sector.
- **Multimodal terminal (MMT)**: As a part of the government's Jal Marg Vikas project (JMVP), recently a MMT became operational on National Waterway 1 for navigation of large vessels weighing up to 1500-2000 tonnes. The objective behind the scheme is to promote inland waterways, primarily for cargo movement.

Student Notes:

- **Multimodal Logistics Parks**: The Government is planning to create a network of **35** Multimodal Logistics Parks to improve the country's logistics sector by lowering overall freight costs, reducing vehicular congestion and cutting warehousing costs.
- **Digital platform**: A **National Logistics Portal** is being developed, which will link all stakeholders of trade including businesses, government departments, etc. on a single platform to ensure ease of trading in the international and domestic markets.
- **Relaxing rules in 'Cabotage law':** Restrictions on foreign registered shipping vehicles have been removed. This will reduce freight rates, promote intra-India freight transportation and consequently make Indian trade more competitive.

Multimodal transport has tremendous potential in aiding India to transform into a $5 trillion economy by 2024. However, both the government and private sector need to work together in this regard.

8. Explaining how the 5G mobile communication technology works, discuss its differences with LTE. Discuss the challenges being faced in its rollout.

Approach:

- Briefly explain what you understand about 5G and discuss how the technology works.
- Discuss some of the key differences between the LTE and 5G Networks.
- State the challenges being faced in its rollout.
- Conclude appropriately.

Answer:

5G is the successor to the fourth generation of cellular mobile communications (LTE-A & WiMax 2) that promises to deliver improved end user experience by offering new use cases through higher data rates, low latency, high reliability and enhanced coverage. Furthermore, it will ensure efficiency across energy consumption, spectrum & network usage.

5G networks use a system of cell sites that divide their territory into sectors and send encoded data through radio waves. Each cell site must be connected to a network backbone, whether through a wired or wireless backhaul connection. 5G networks use a type of encoding called Orthogonal Frequency-Division Multiplexing (OFDM), which is similar to the encoding that 4G LTE uses. However, the new 5G NR (New Radio) will further enhance OFDM to deliver a much higher degree of flexibility, speed and scalability. 5G incorporates advanced wireless technology such as massive MIMO (multiple-input and multiple-output) i.e. use of multiple targeted beams to spotlight and follow users around a cell site.

Some of the key differences between the LTE and 5G networks are:

- **Capacity:** 5G will be able to boost capacity by four times over the current systems by leveraging wider bandwidths and advanced antenna technologies. Further, it can support a 100x increase in traffic capacity and network efficiency.
- **Speed:** 5G will deliver up to 20 Gigabits-per-second peak data rates and 100+ Megabits-per-second average data rates. It is expected to be nearly 100 times faster than 4G LTE network.
- **Spectrum support:** 5G will provide much more network capacity by supporting all spectrum types (licensed, shared, unlicensed) and bands (low, mid, high).
- **Frequency:** 5G will operate at **much higher frequencies** in the 30 GHz to 300 GHz range.

Student Notes:

- **Latency:** 5G has **lower latency** LTE networks i.e**.** lag time in communications between devices and servers. Latency for 4G is around 20-30 milliseconds, but for 5G it will be below 10 milliseconds.
- **Device support:** 5G will support **more connected devices** than the LTE networks, using a wide range of deployment models and new ways to interconnect.

Challenges being faced in its rollout include:

- **5G technology is at a nascent stage** and research on its viability is still going on.
- A few Chinese corporations such as Huawei and ZTE Corporation dominate the 5G network. Their access to global data could potentially raise **economic and security threats.**
- Developing infrastructure and technology for 5G requires **high cost.** 5G deployment will also involve a heavy upfront investment with a long payback period.
- **Many of the devices will not be competent with 5G** and will require a fundamental change to their core communication architecture.
- Shifting to 5G technologies would require **massive up-gradation of the existing networks and antennae.**
- Telecom operators are still trying to fully monetize 4G services. Further, there is a need of a **reasonable spectrum pricing and swift allocation** of spectrum.

5G is seen as a likely game changer for India, with the potential to create an economic impact of more than US$1 trillion by 2035. The government should take definitive measures for its growth, such as push for 'Make in India' manufacturing for 5G equipment and handsets, public-private partnerships for broadband growth and penetration, indigenous technology advancements through R&D etc. India should also forge global partnerships in the development of 5G technology and become an active stakeholder.

9. The role of international trade in achieving a quicker pace of economic development is well recognized. What are the benefits of international trade for a developing country like India? Highlight the challenges that India faces in improving its share in world trade.

Approach:

- State the importance of international trade in economic growth and development.
- Enumerate the benefits of international trade for developing countries with focus on India.
- Examine the challenges that India faces in improving its share in the world trade.
- Conclude with recommendations.

Answer:

The 2030 Agenda for Sustainable Development recognizes international trade as an engine for inclusive economic growth and poverty reduction. India's foreign trade policy set a target of $ 900 billion for India's export of goods and services by 2019-20. India's international trade accounts for about 20% of India's GDP.

Benefits of international trade

- International trade enhances competitiveness by helping developing countries reduce cost of inputs and acquire finance through investments
- It facilitates export diversification by allowing developing countries to access new markets and new materials which open up new production possibilities.
- It encourages innovation by facilitating exchange of know-how, technology and investment in research and development, including through FDI.

Student Notes:

- Openness in trade expands business opportunities for local companies by opening up new markets, removing unnecessary barriers and making it easier for them to export.
- Trade creates employment opportunities by boosting economic sectors that create stable jobs and usually higher incomes, thus improving livelihoods.
- Trade strengthens ties between nations by bringing people together in peaceful and mutually beneficial exchanges and as such contributes to peace and stability.

A very important aspect of international trade is growth. Growth driven only by internal consumption is limited and will reach its limits very soon. In order to grow, a country needs to trade with economic agents outside its borders. This benefits both the trading partners, although unequally in the short run. The more competitive economy reaps more benefits as compared to the less competitive one.

Challenges

- Foreign Trade Policy 2015-20 acknowledged that the biggest hurdles to India's competitiveness lie on the domestic front, which include:
  - infrastructure bottlenecks,
  - high transaction costs,
  - complex procedures such as many trade barriers, quotas etc
  - inadequacy of trade information system and institutional rigidities
- Developing countries in general export mostly primary products such as agricultural commodities which have price and demand inelasticity.
- Rise in protectionism in West resulting in increase of tariff and non-tariff barriers.
- Export subsidies provided by developed countries create unfair competitive advantage to recipients.
- Lack of cooperation among countries in regional, multilateral and bilateral groupings impact international trade baskets of developing countries.
- Lobbying by developed countries at forums like WTO also thwart international trade especially in food security regulations that have impacted ongoing negotiations with developing countries.

Recommendations:

- A forward-looking trade policy must accompany rationalization of tariff structure while increasing compliance to technical, sanitary and phytosanitary standards.
- International trade policy must also reconfigure its trade promotion incentives from handing out financial sops to better helping exporters attain competitiveness.
- Sectoral focus like bringing the, 'National Agriculture Export Policy' with a vision to doubling farmers' income and increasing share of agricultural exports from present about USD 30 billion to over USD 60 billion by 2022.
- Accelerated implementation of Trade Facilitation Agreement (TFA) of WTO.

Further, India should actively advocate for multilateral version as against the fragmented version of international trade in order to reap the full benefits offered by the globalized world. This would contribute to sustainable economic development in the long run.

Student Notes:

10. India's trade policy in agriculture, marred by ad-hocism and pro-consumer bias, has constrained realization of export potential, and prevented the farmers from reaping the benefits. Examine the statement and discuss ways, including government initiatives, to improve agricultural exports.

Approach:

- Briefly write about India's agriculture trade. .
- Explain the ad-hocism and pro-consumer bias in India's trade policy in agriculture and its impacts.
- Enumerate the ways to improve agricultural exports.

Answer:

Economic Reforms of 1991 has led to the opening of Indian economy which allowed agriculture exports and imports. In 1990-91, agriculture exports contribution was less than 5% of agri-GDP and it reached around 20% of agri-GDP in the year 2013-14. However, the share of agricultural exports in total exports has reduced from 18.5% in 1990- 91 to 12.7% in 2014-15 and it accounts for only a little over 2% of world agriculture trade, which is far from the potential of the sector. Further, the ad-hoc policy measures have created a skewed policy regime.

The ICRIER has reported that in last two decades, time and again the government has resorted to export restriction measures like export ban and high minimum export prices (MEP) to prevent inflationary pressures, which has hindered the growth of agriculture export sector and deprives farmers of high income.

The export restriction at the time of high global prices has also discouraged farmers from cultivating exportable crops. This has also led to instability in the investment policy framework in the agro-processing industry, misaligned Indian prices from international prices and led to cropping distortions. Such ad-hocism is unsustainable and antithesis to creation of a fair and competitive environment, which can be advantageous for farmers. Further, the lack of marketing chains and poor agricultural infrastructure has prevented the growth of agriculture export sector.

To double the agriculture export by 2022 and generate employment in agriculture sector, following steps needs to be taken:

- The Food ministry and Agriculture ministry should work in tandem to ensure low food prices and high price for farm produce.
- Ensure better coordination between Centre and state governments to usher reforms in the agriculture sector.
- Overhaul the Essential Commodities Act and APMC Act to fine tune with the need of hour so that competitiveness can be encouraged at pricing, procuring, stocking and trading of commodities.
- The government should create viable space for the private sector in marketing infrastructure, tapping market signals and global price trends while deciding minimum support prices.
- Eliminate restrictions in the form of a minimum export price (MEP), export duty or ban on processed agriculture products or organic products.
- Create a predictable and stable policy regime.

Overall, policy actions are required to strike a balance between the needs of farmer on one side and consumer on the other. Farmers should be able to get remunerative price for their produce in domestic or international market and should not bear the burden of keeping food prices low.

Student Notes:

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LOCATION OF INDUSTRIES

Student Notes:

Contents

Student Notes:

1. Factors affecting Location of Industries

The location of industry at a particular place is the result of a number of decisions taken at various levels. There are certain geographical factors which facilitate this decision making. There are other factors which fall outside the subject matter of geography. The validity or importance of a factor also changes with time and space.

Industries maximise profits by reducing costs. Therefore, industries should be located at points where the production costs are minimum. Some of the factors influencing industrial locations are as under:

1.1. Access to Market

The existence of a market for manufactured goods is the most important factor in the location of industries. 'Market' means people who have a demand for these goods and also have the purchasing power (ability to purchase) to be able to purchase from the sellers at a place. Many industries are located near large urban centres because the concentration of population in those areas ensures readily available market. Remote areas inhabited by a few people offer small markets.

The developed regions of Europe, North America, Japan and Australia provide large global markets as the purchasing power of the people is very high. The densely populated regions of South and South-east Asia also provide large markets. Some industries, such as aircraft manufacturing, have a global market. The arms industry also has global markets.

1.2. Access to Raw Material

Raw material used by industries should be cheap and easy to transport. Raw materials are the basic requirements for manufacturing industry. Some raw materials lose weight during processing but others do not. **Industries based on cheap, bulky and weight-losing material (ores) are located close to the sources of raw material such as steel, sugar, and cement industries**. *Perishability* is a vital factor for the industry to be located closer to the source of the raw material. Agro-processing and dairy products are processed close to the sources of farm produce or milk supply respectively.

Many industries do not require much of raw materials and these can be located anywhere independent of raw material sources such as garment and electronic industries. There are some industries which are not wedded to any particular raw material. Such industries are known as *foot-loose* industries.

With the expansion and development of means of transportation the role of raw materials in location of industries has almost lost its significance. The establishment of iron and steel industry in Japan and cotton textile industry in Liverpool prove the fact that the multi-nationals and countries with sufficient capital can manipulate the means of transportation in their favour and obtain raw materials.

1.3. Access to Labour Supply

Labour supply is an important factor in the location of industries. Two aspects of labour are important for the location of industry. **First, the availability of cheap labour in large numbers and second, the level of their skills**. For labour intensive industries, cheap labour should be available. Skilled labour is costly but their efficiency and skill compensate for the higher wages. Some industries are located at a particular place due to the availability of skilled labour like electronic industry in Japan, glass industry in Ferozabad (Uttar Pradesh) and utensil industry in Jagadhari and Moradabad.

Labour is more mobile than other factors of production. It can be moved from villages to towns, from towns to metropolis, from one industry or place to another or even from one

country to the other country. This mobility is namely ascribed to differential wage rates in different situations.

Student Notes:

1.4. Access to Sources of Energy

In the earlier phase of the industrial revolution, the industries were generally located near the source of energy as they have fixed locations. Now, large scale generation of hydroelectric power and ability to transmit at high voltage to far off places and proper distribution over larger areas through grid system have made it possible to take the energy to any location. Thus the dependence of industries for their location on energy resources has considerably reduced. However, some energy intensive industries such as aluminium industry are still located near the energy sources.

1.5. Access to Transportation and Communication Facilities

Speedy and efficient transport facilities to carry raw materials to the factory and to move finished goods to the market are essential for the development of industries. The cost of transport plays an important role in the location of industrial units. **Modern industry is inseparably tied to transportation systems. Improvements in transportation led to integrated economic development and regional specialisation of manufacturing.**

The means of transportation help in the development of industry. **At the same time, after the location of industries at a place, the means of transportation also develop very fast.** The concentration of large industries in the Great Lakes region has been caused by cheap means of water transportation provided by the lakes. Almost all large industrial towns in Japan are ports. The cheap water transport has facilitated the development and concentration of Jute mills in the Hoogly valley in India and large industrial towns in the Rhine valley of Europe.

1.6. Government Policy

Sometimes Government adopt 'regional policies' to promote 'balanced' economic development and hence set up industries in particular areas.

1.7. Access to Agglomeration Economies/Links Between Industries

Many industries benefit from nearness to a leader-industry and other industries. These benefits are termed as agglomeration economies. Savings are derived from the linkages which exist between different industries.

1.8. Other Miscellaneous Factors

Some other factors are crucial for the location of certain industries, for example, the cotton mills were established earlier in the hinterland of Bombay because coastal location provided high humidity in the air. It prevented the yarn from breaking. Now it is possible to maintain the required amount of humidity in the mills with technological intervention. It is therefore, possible to establish spinning mills away from the coast.

Water is an important factor in industrial location. It is required in large quantities in cotton textile industry for bleaching and in Iron and steel industry for cooling. It is possible, now, to carry water from one place to the other through pipelines. In certain situations the demand of water is so large that it cannot be met through transportation of water and such establishments are taken to the sources of water such as nuclear reactors.

The location of some industries is decided by institutional factors like historical, social and political decisions. Location of industries in backward regions in order to reduce economic disparity and shifting of industries to the interior parts of a country due to strategic reasons during war are examples of institutional decisions in the location of industries.

So, the location of modem industries is not guided by a single factor due to its complex nature. All aspects have to be considered and analysed before deciding location of industries.

Student Notes:

2. Primary Activities

Primary activities are directly dependent on environment as these refer to utilisation of earth's resources such as land, water, vegetation, building materials and minerals. It, thus includes, hunting and gathering, pastoral activities, fishing, forestry, agriculture, and mining and quarrying.

2.1. Hunting and Gathering

The earliest human beings depended on their immediate environment for their sustenance. They subsisted on: (a) animals which they hunted; and (b) the edible plants which they gathered from forests in the vicinity.

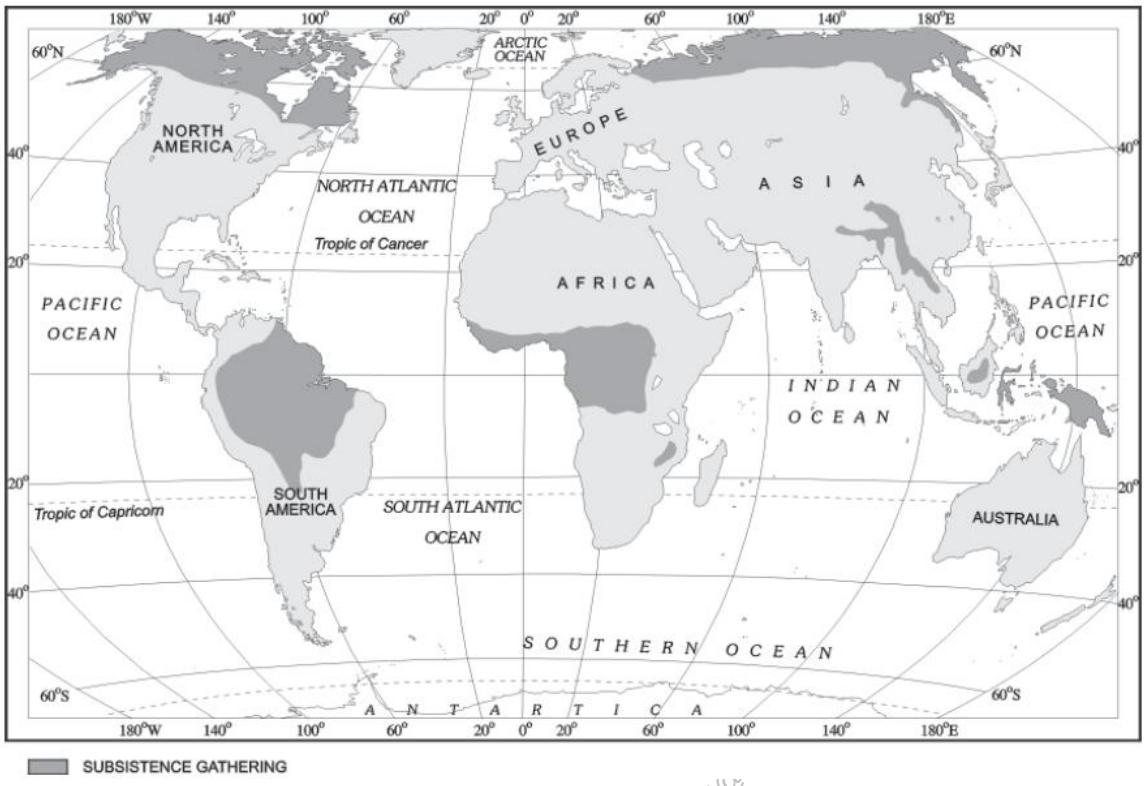


Fig 1. Areas of Gathering

Gathering is practised in regions with harsh climatic conditions. It often involves primitive societies, which extract, both plants and animals to satisfy their needs for food, shelter and clothing. This type of activity requires a small amount of capital investment and operates at very low level of technology. The yield per person is very low and little or no surplus is produced.

Gathering is practised in:

- High latitude zones which include northern Canada, northern Eurasia and southern Chile;
- Low latitude zones such as the Amazon Basin, tropical Africa, Northern fringe of Australia and the interior parts of Southeast Asia.

In modern times some gathering is market oriented and has become commercial. Gatherers collect valuable plants such as leaves, barks of trees and medicinal plants and after simple processing sell the products in the market.

2.2. Pastoralism or Animal Rearing

At some stage in history, with the realisation that hunting is an unsustainable activity, human beings thought of **domestication of animals**. People living in different climatic conditions

selected and domesticated animals found in those regions. Depending on the geographical factors, and technological development, animal rearing today is practised either at the subsistence or at the commercial level.

Student Notes:

2.2.1. Nomadic Herding

Nomadic herding or pastoral nomadism is a primitive subsistence activity, in which the herders rely on animals for food, clothing, shelter, tools and transport. They move from one place to another along with their livestock, depending on the amount and quality of pastures and water. A wide variety of animals is kept in different regions. In tropical Africa, cattle are the most important livestock, while in Sahara and Asiatic deserts, sheep, goats and camel are reared. In the mountainous areas of Tibet and Andes, yak and llamas and in the Arctic and sub-Arctic areas, reindeer are the most important animals.

Pastoral nomadism is associated with three important regions. **The core region extends from the Atlantic shores of North Africa eastwards across the Arabian peninsula into Mongolia and Central China. The second region extends over the tundra region of Eurasia. In the southern hemisphere there are small areas in South-West Africa and on the island of Madagascar**.

2.2.2. Commercial Livestock Rearing

Unlike nomadic herding, commercial livestock rearing is more organised and capital intensive. Commercial livestock ranching is essentially associated with western cultures and is practised on permanent ranches. These ranches cover large areas and are divided into a number of parcels, which are fenced to regulate the grazing. When the grass of one parcel is grazed, animals are moved to another parcel. The number of animals in a pasture is kept according to the carrying capacity of the pasture.

New Zealand, Australia, Argentina, Uruguay and United States of America are important countries where commercial livestock rearing is practised.

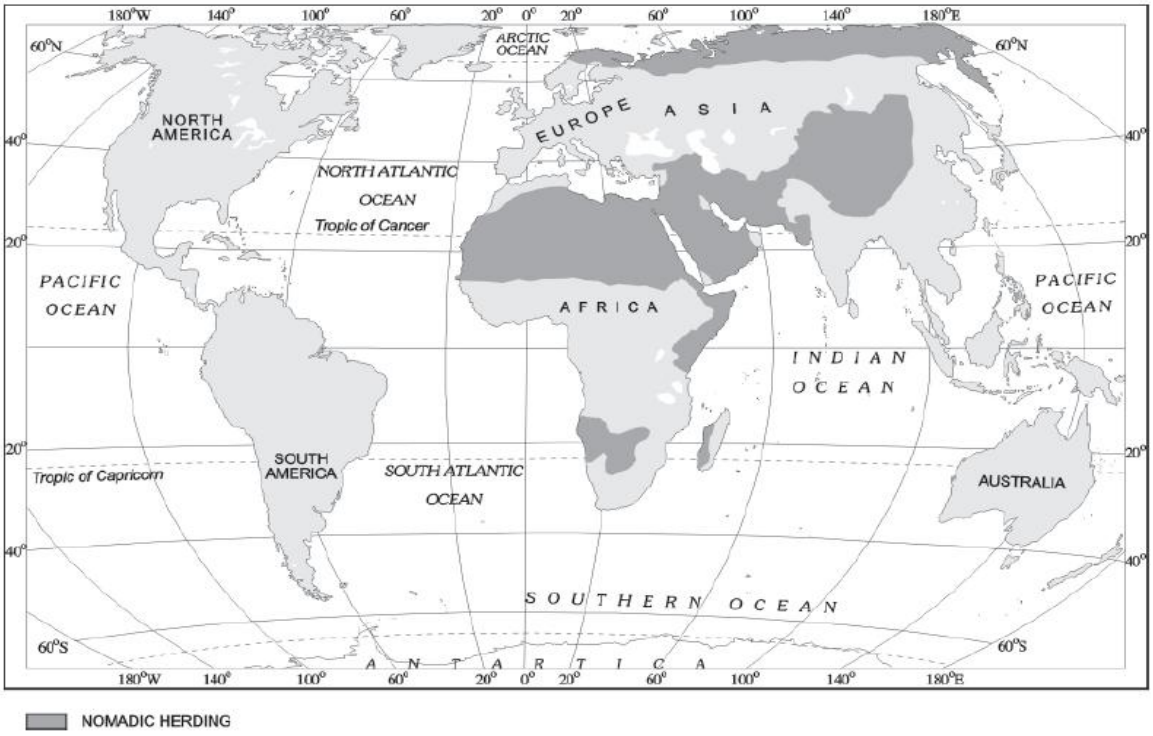


Fig. 2 Areas of Nomadic Herding

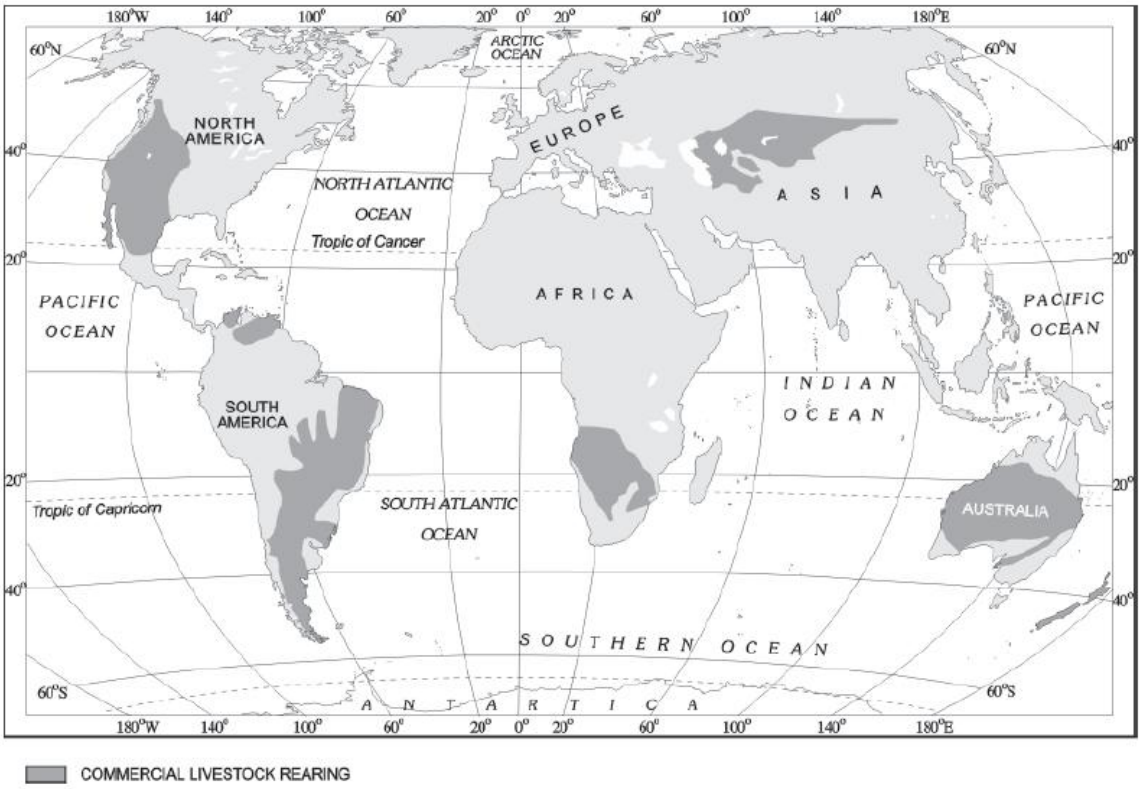


Fig. 3 Areas of Commercial Livestock Rearing

2.3. Agriculture

Agriculture is practised under multiple combinations of physical and socio-economic conditions, which gives rise to different types of agricultural systems. The following are the main agricultural systems:

2.3.1. Subsistence Agriculture

Subsistence agriculture is one in which the farming areas consume all, or nearly so, of the products locally grown. It can be grouped in two categories — Primitive Subsistence Agriculture and Intensive Subsistence Agriculture.

2.3.1.1. Primitive Subsistence Agriculture

Primitive subsistence agriculture or shifting cultivation is widely practised by many tribes in the tropics, especially in **Africa, south and Central America and South East Asia**. The vegetation is usually cleared by fire, and the ashes add to the fertility of the soil. Shifting cultivation is thus, also called **slash and burn agriculture**.

It is prevalent in tropical region in different names, e.g. **Jhuming** in North eastern states of India, **Milpa** in Central America and Mexico and **Ladang** in Indonesia and Malaysia.

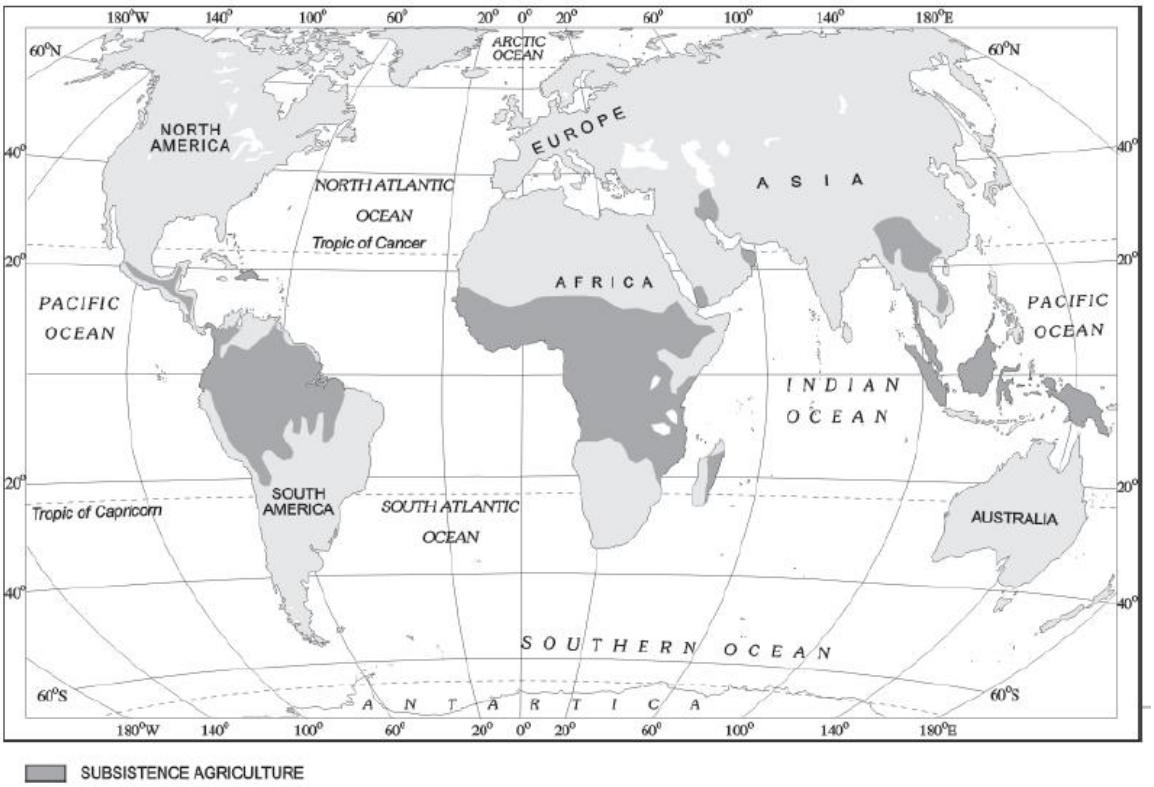


Fig. 4 Areas of Primitive Subsistence Agriculture

2.3.1.2. Intensive Subsistence Agriculture

This type of agriculture is largely found in densely populated regions of monsoon Asia. There are two types of intensive subsistence agriculture:

1. ***Intensive subsistence agriculture dominated by wet paddy cultivation:*** This type of agriculture is characterised by dominance of the rice crop. Land holdings are very small due to the high density of population.
2. ***Intensive subsidence agriculture dominated by crops other than paddy:*** Due to the difference in relief, climate, soil and some of the other geographical factors, it is not practical to grow paddy in many parts of monsoon Asia. Wheat, soyabean, barley and sorghum are grown in northern China, Manchuria, North Korea and North Japan. In India wheat is grown in western parts of the Indo-Gangetic plains and millets are grown in dry parts of western and southern India.

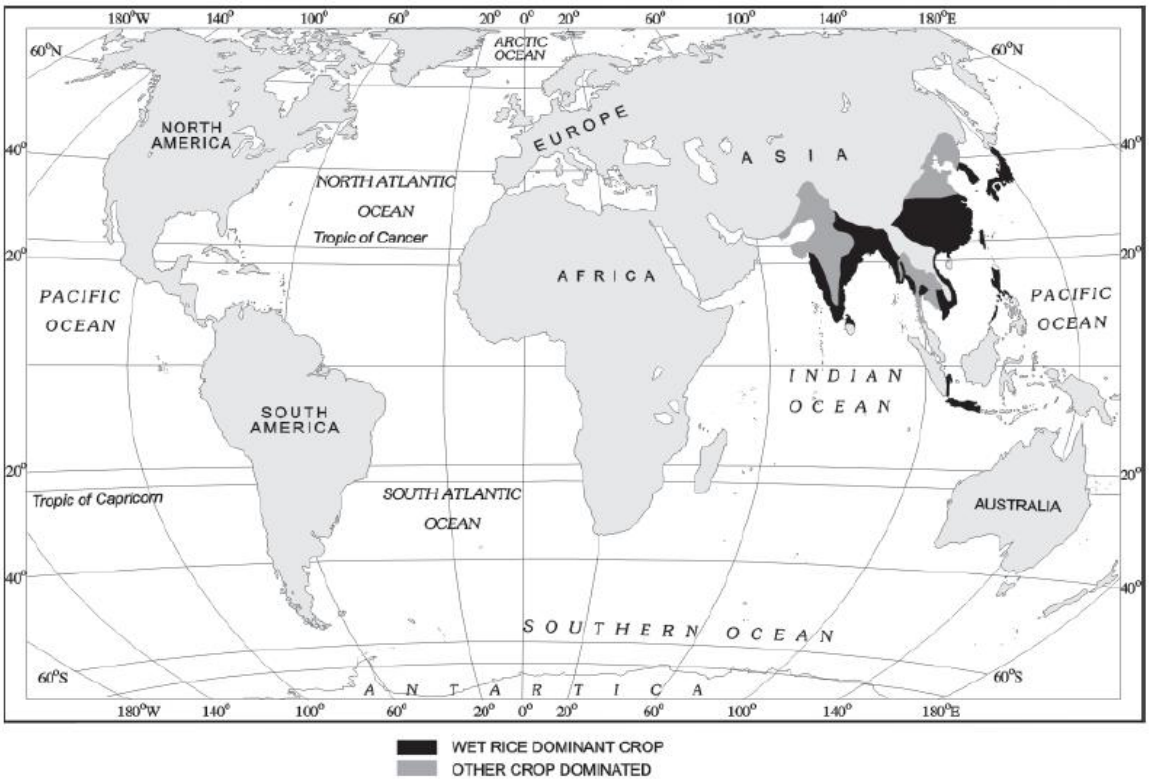


Fig. 5 Areas of Intensive Subsistence Agriculture

2.3.2. Plantation Agriculture

Plantation agriculture as mentioned above was introduced by the Europeans in colonies situated in the tropics. Some of the important plantation crops are tea, coffee, cocoa, rubber, cotton, oil palm, sugarcane, bananas and pineapples. The characteristic features of this type of farming are large estates or plantations, large capital investment, managerial and technical support, scientific methods of cultivation, single crop specialisation, cheap labour, and a good system of transportation which links the estates to the factories and markets for the export of the products.

The French established cocoa and coffee plantations in west Africa. The British set up large tea gardens in India and Sri Lanka, rubber plantations in Malaysia and sugarcane and banana plantations in West Indies. Spanish and Americans invested heavily in coconut and sugarcane plantations in the Philippines. The Dutch once had monopoly over sugarcane plantation in Indonesia.

2.3.3. Extensive Commercial Grain Cultivation

Commercial grain cultivation is practised in the interior parts of semi-arid lands of the mid-latitudes. Wheat is the principal crop, though other crops like corn, barley, oats and rye are also grown. **This type of agriculture is best developed in Eurasian steppes, the Canadian and American Prairies, the Pampas of Argentina, the Velds of South Africa, the Australian Downs and the Canterbury Plains of New Zealand.**

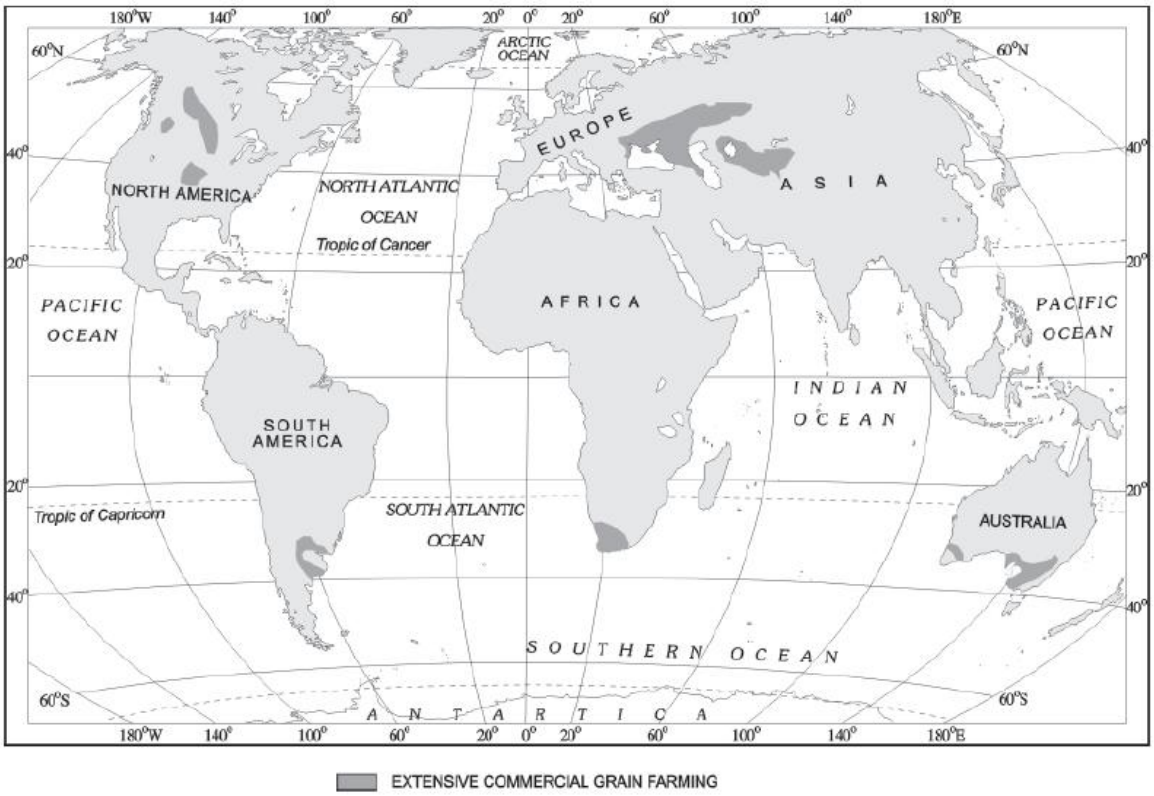


Fig 6. Areas of Extensive Commercial Grain Cultivation

2.3.4. Mixed Farming

Mixed farms are moderate in size and usually the crops associated with it are wheat, barley, oats, rye, maize, fodder and root crops. Fodder crops are an important component of mixed farming. Equal emphasis is laid on crop cultivation and animal husbandry. Animals like cattle, sheep, pigs and poultry provide the main income along with crops.

This form of agriculture is found in the highly developed parts of the world, e.g. North-western Europe, Eastern North America, parts of Eurasia and the temperate latitudes of Southern continents.

2.3.5. Dairy Farming

It is practised mainly near urban and industrial centres which provide neighbourhood market for fresh milk and dairy products. The development of transportation, refrigeration, pasteurisation and other preservation processes have increased the duration of storage of various dairy products.

There are three main regions of commercial dairy farming. The largest is **North Western Europe** the second is **Canada** and the third belt includes **South Eastern Australia, New Zealand and Tasmania**.

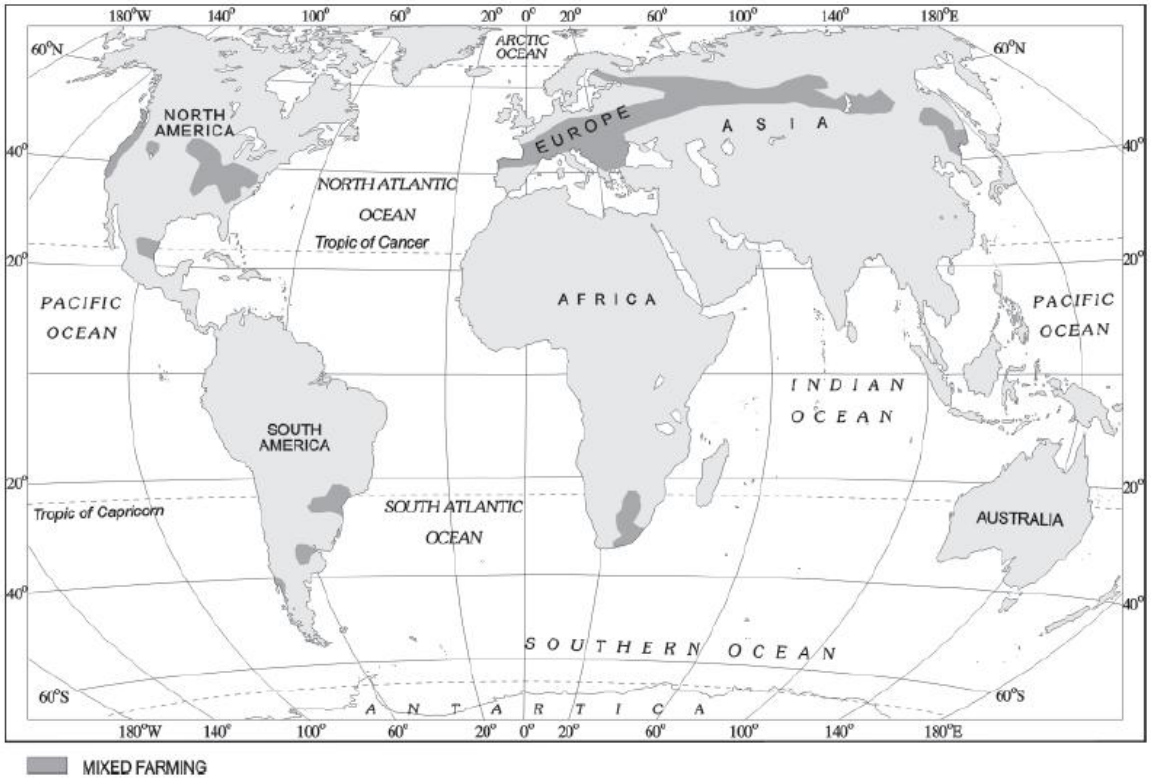


Fig. 7 Areas of Mixed Farming

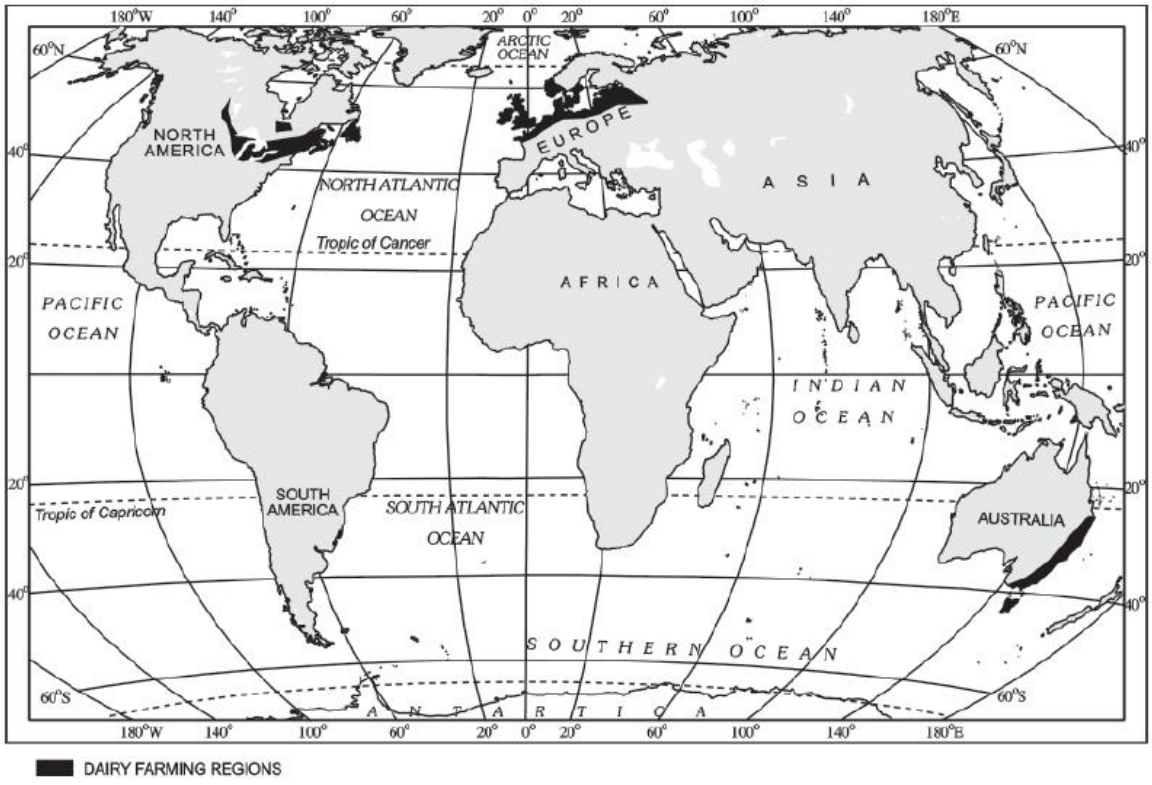


Fig. 8 Areas of Dairy Farming

2.3.6. Mediterranean Agriculture

Mediterranean agriculture is highly specialised commercial agriculture. **It is practised in the countries on either side of the Mediterranean Sea in Europe and in north Africa from Tunisia to Atlantic coast, southern California, central Chile, south western parts of South Africa and south and south western parts of Australia.** This region is an important supplier of citrus fruits.

Viticulture or grape cultivation is a speciality of the Mediterranean region. Best quality wines in the world with distinctive flavours are produced from high quality grapes in various countries of this region.

Student Notes:

2.3.7. Market Gardening and Horticulture

Market gardening and horticulture specialise in the cultivation of high value crops such as vegetables, fruits and flowers, solely for the urban markets. Farms are small and are located where there are good transportation links with the urban centre where high income group of consumers is located.

This type of agriculture is well developed in densely populated industrial districts of **north west Europe, north eastern United States of America and the Mediterranean regions**. The **Netherlands** specialises in growing flowers and horticultural crops especially tulips, which are flown to all major cities of Europe.

2.3.8. Co-operative Farming

Co-operative societies help farmers, to procure all important inputs of farming, sell the products at the most favourable terms and help in processing of quality products at cheaper rates. Co-operative movement originated over a century ago and has been successful in **many western European countries like Denmark, Netherlands, Belgium, Sweden, Italy** etc. In Denmark, the movement has been so successful that practically every farmer is a member of a co-operative.

2.3.9. Collective Farming

The basic principal behind this type of farming is based on social ownership of the means of production and collective labour. Collective farming or the model of **Kolkhoz** was introduced in **erstwhile Soviet Union** to improve upon the inefficiency of the previous methods of agriculture and to boost agricultural production for self-sufficiency.

The farmers pool in all their resources like land, livestock and labour. However, they are allowed to retain very small plots to grow crops in order to meet their daily requirements. Yearly targets are set by the government and the produce is also sold to the state at fixed prices. Produce in excess of the fixed amount is distributed among the members or sold in the market. The farmers have to pay taxes on the farm produces, hired machinery etc. **This type of farming was introduced in former Soviet Union under the socialist regime which was adopted by the socialist countries**. After its collapse, these have already been modified.

2.4. Mining

The use of minerals in ancient times was largely confined to the making of tools, utensils and weapons. The actual development of mining began with the industrial revolution and its importance is continuously increasing.

The profitability of mining operations depends on two main factors:

1. Physical factors include the size, grade and the mode of occurrence of the deposits.
2. Economic factors such as the demand for the mineral, technology available and used, capital to develop infrastructure and the labour and transport costs.

The developed economies are retreating from mining, processing and refining stages of production due to high labour costs, while the developing countries with large labour force and striving for higher standard of living are becoming more important. Several countries of Africa and few of South America and Asia have over fifty per cent of the earnings from minerals alone.

Student Notes:

3. Manufacturing Activities

Manufacturing activities add value to natural resources by *transforming* raw materials into valuable products. Manufacturing involves the application of power, mass production of identical products and specialised labour in factory settings for the production of standardised commodities. Manufacturing may be done with modern power and machinery or it may still be very primitive.

Some of the major manufacturing industries and their locations are discussed below.

3.1. Iron and Steel Industry

Iron and steel industry is Important in United States of America, Soviet Union, European countries, Australia and India. Japan, South Africa, Brazil and Colombia are other Iron and steel producing countries. Continent wise distribution can be discussed as under:

3.1.1. America

The Great Lakes region in United States of America is the leading iron and steel producing region. The good quality coke is available from **Pennsylvania**. Iron ore is brought from the mines of **Lake Superior region**. Limestone is obtained from the neighbourhood of Alpena located on the western coast of Lake Huron. Water is available in plenty from the local rivers and lakes for cooling. This part of United States is densely populated which ensures large supply of labour. The high density of population and development of iron and steel based industries have created large market in this region. **Pittsburgh and Youngtown to the east of the Great Lakes and Chicago and Gary to its west are the major centres of iron and steel industries.**

There is a great demand for iron and steel in the industrial complexes of Detroit, Toledo and Cleveland as well as the rail industry of Chicago. The demand for iron ore is high in the industries located on the coasts of Lake Erie. It is met from the mines of Lake Superior region and the Labrador mines. They are brought by ships through St. Lawrence Seaway.

Iron and steel Industry has also developed in the **Atlantic coastal region**. **Iron ore is imported from Venezuela, Labrador and Chile as the coast location has facilitated the oceanic transport**. **Alabama** is the third important Iron and steel producing region. **Birmingham** is the most important iron and steel centre of this region.

The iron and steel industry in South America is located in **Colombia, Venezuela and Brazil**. In **Colombia**, coal is available from Tunza district located north of Bogota, iron ore and limestone is available locally and hydro-electric power is obtained from Toba Lake. In **Venezuela**, the iron and steel industry is based on the iron ore from El Pao, Serra Bolivar and Dagiana Hills, coal and limestone from Nankol and hydroelectric power from Caroni river. The iron and steel industry in **Brazil** developed after the Second World War. The main steel plants in Brazil are located are located at Volta Redona, Montevarde and Santos. **Chile** is also an important steel producing country of South America.

3.1.2. Europe

The Second World War created a situation before west European nations that they had to turn towards cooperation rather than competing with each other. Six countries joined together to form a cooperative community in 1952. France, Germany, Netherlands, Belgium, Luxembourg and Italy became its members. In 1973, United Kingdom, Ireland and Denmark also joined it. It is known as European Coal and Steel Community. The major objective of the community is to provide facilities for the supply of iron ore and coal to the members of the community without any hindrance. Earlier, iron and steel industry in Europe was closely linked with coal mines but now some industries have moved to the port towns and some have been established near the iron ore mines.

Student Notes:

The iron and steel industry in **Europe** has developed in **France-Belgium, Loraine (France) – Luxembourg – Saar (Germany), Ruhr (Germany) and north, north-eastern and central parts of United Kingdom.** Loraine has the largest iron-ore reserve in Europe. Ruhr region has high quality coking coal. Rhine River and the canal network developed in the region provide cheap water transport. Demand for iron and steel in the local industries is large as most of the west European countries have high level of industrialisation.

In **United Kingdom** some iron and steel industries are located near the coal mines such as **Birmingham**. Some are located near the iron ore mines such as **Fordingham** and some are located near the ports like **Talbot**. Other iron and steel producing countries of Europe are Sweden, Poland and Czechoslovakia.

Iron and steel industry has developed in **southern Ukraine** which is based on the iron ore from **Krivoy Rog and Kerch peninsula, coal from Donetsk Basin (Donbas) and local manganese. The Ural region is another important steel producing region of Russia.** Iron ore in this region is obtained from Magnet Mountains, coal from Kuznetsk Basin (Kuzbas) and Karaganda basin. Trans-Siberian railway provides surface transport. Sverdlovsk, Magnitogorsk and Nizhny Tagil are major iron and steel centres. Besides these major regions, Iron and steel industry has also been located in Kuzbas and Caucasus region.

3.1.3. Asia

In Asia, iron and steel industry has developed in **Japan, China and India.**

The iron and steel industry in Japan developed in response to the large demand in engineering, and ship-building industry. This demand accounts for the rapid development of iron and steel industry in Japan in spite of the fact that she neither had large Iron ore deposits nor coal reserves. **Kyushu island of Japan has very limited coal reserves.** Japan imports large quantities of coke, iron ore, pig iron as well as scrap iron. **The iron and steel industry has been located in southern Honshu and northern Kyushu Islands.**

The history of the development of iron and steel industry in **China** started in the post revolution period i.e. after 1949, though Japanese had established it at Anshan and Fushan in Manchuria earlier. **Besides Manchuria, Shanxi, Shenxi, Hobei and Shandong are the major iron and steel producing provinces.**

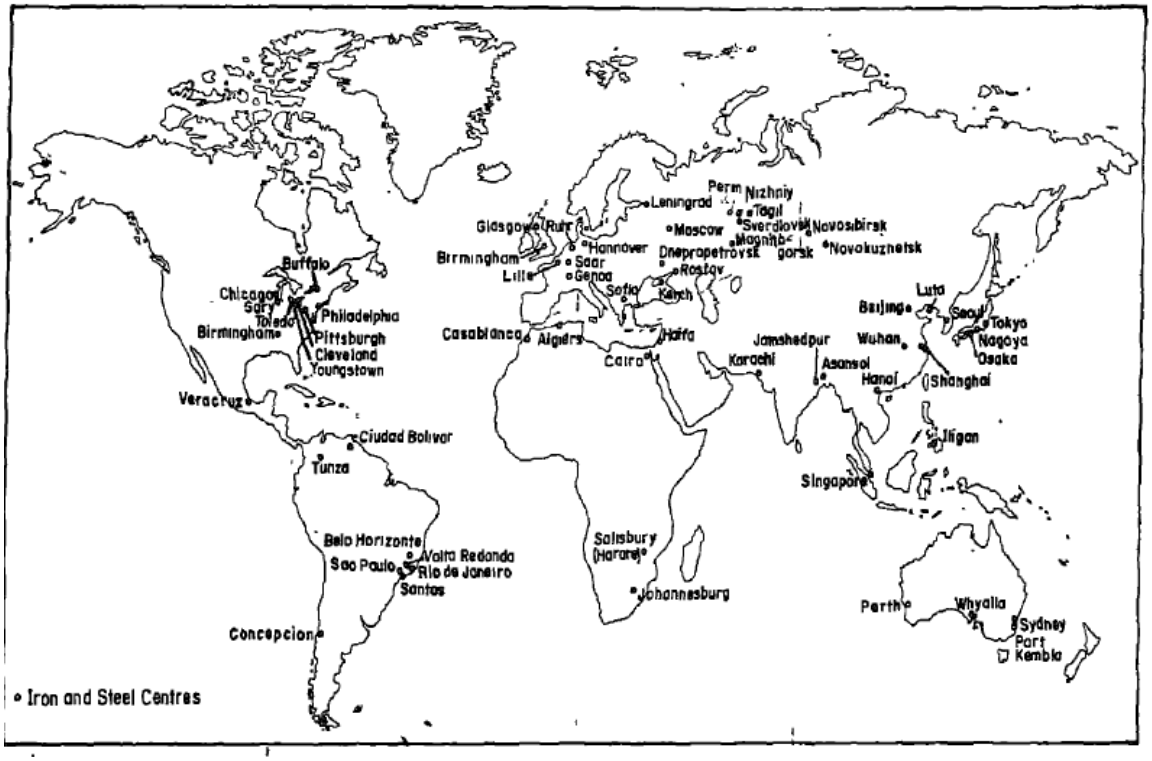


Fig. 9 World- Iron and Steel industry

Three iron and steel plants were established in India before Independence. Two of these were located at **Jamshedpur and Kulti -Burnpur** based on the iron ore, coal and manganese resources of Bihar, West Bengal and Orissa. **Mysore Steel Works at Bhadravati** was established by exploiting the iron ore resources of Karnataka. **In India, iron ore reserves are located in Keonjhar, Mayurbhanj, Guru Mahisani, Badam Pahar, Bonai and Noamundi. Coal is available from Jharia, Raniganj, Karnpura, Giridhih, Talchir, Singrauli and Korba. Manganese is obtained from Bonai and limestone from Birmitrapur.** The high density of population in eastern India provides cheap labour. There is a dense network of rail and roads. Water is available from rivers. The industrial hinterland of Calcutta has large demand for Iron and steel. This is why three Iron and steel plants i.e. Durgapur, Rourkela and Bokaro, have been established in this region after independence. Bhilai was located in backward tribal region in order to reduce the regional imbalance in economic development..

3.1.4. Australia

Australian Iron and steel industry is based on the coal found in the **Hunter valley of New Castle**. It is located on the eastern coast. **There is an iron and steel plant at Port Kembla in the south of Sydney**.

3.1.5. Africa

Iron and steel industry has developed in Algeria, Egypt, Zimbabwe and South Africa. South Africa is the major steel producing country in Africa. The industry at Vereeniging utilizes scrap iron and pig iron from Natal.

3.2. Chemical Industry with Special Reference to Petro-chemicals

Chemical industry is based on two types of raw materials: **natural** like minerals, coal, petroleum, salts, potash, sulphur, limestone, gypsum and vegetable products and **by products** of other industries such as paper and pulp industry, iron and steel industry and gas manufacturing industry. **Major factor for the location of chemical industry are availability of raw materials, cheaper means of transport for bulky materials, water supply, sources for energy and demand of chemicals in other industries.**

Student Notes:

The major industry based on mineral oil is its refining. The oil refining technology was developed in United States of America, Europe and former USSR. Earlier the refineries were generally located near the oil wells. The petrochemical industry developed in Europe and United States of America after the Second World War. **The development of large tankers and pipelines facilitated the transportation of petroleum in bulk and this provided favourable conditions for locating the refineries and petro-chemical industries near the markets as well as ports.**

3.2.1. America

Most of the petro-chemical complexes in North-America are located in the coastal regions. **About 30 per cent of the oil in United States of America is refined along the Gulf of Mexico coast and another 15 per cent is refined on the Pacific Coast**. The refineries located on the East Coast get crude oil from Venezuela and West Asia. The refined oil is transported from the Gulf Coast to the eastern region through pipelines and to the west by tankers. **Petro-chemical complexes have developed in Philadelphia and Delaware in the eastern region and at Chicago and Toledo in the Great Lakes region.**

Los Angeles has a big petrochemical complex on the western coast of United States. In **Canada, Montreal** has a large petro-chemical industry. The crude oil is brought from **Portland** and **Maine** through pipelines and by tankers from **Venezuela.** The other important petrochemical complex in **Canada** is located at **Sarnia** in **Ontario province.**

After the Second Wold War, a refinery was constructed in the Paraguayan Peninsula of Venezuela which receives crude oil through pipelines from the wells located near **Maracaibo Lake.**

3.2.2. Europe

The petro-chemical complexes in Europe are located near the markets where these products are demanded. The major complexes are located on the **coasts of Southern North Sea** and **English Channel.** Main centres are **Antwerp**, **Rotterdam**, **Southampton** and the **cities located in the lower Sein Valley**. The petro-chemical complexes of **Germany** are located in **Ruhr region**. The **French** refineries and petro-chemical complexes are concentrated between **Le Havre-Roven and Marseilles including Paris and Lyons**. The first petro-chemical complex in former **Soviet Union** was located at **Baku and Grozny because the mineral oil was available from the Caucasian oil fields**. New petro - chemical complexes are generally located near the consumption centres. **Moscow, Volga, Ural and Soviet Central Asia** are the main regions where new petro-chemical complexes have been recently located.

3.2.3. West Asia

The largest refinery in **West Asia is located at Abadan** (Iran). **West Asia is a large producer of petroleum but there is little demand because the region is not industrially developed. Thus, most of the petrochemical complexes are located on the coasts in order to facilitate export. Saudi Arabia has a large petro-chemical complex at Ras Tanura while Mina-el-Ahmadi is the largest petro-chemical complex of Kuwait**.

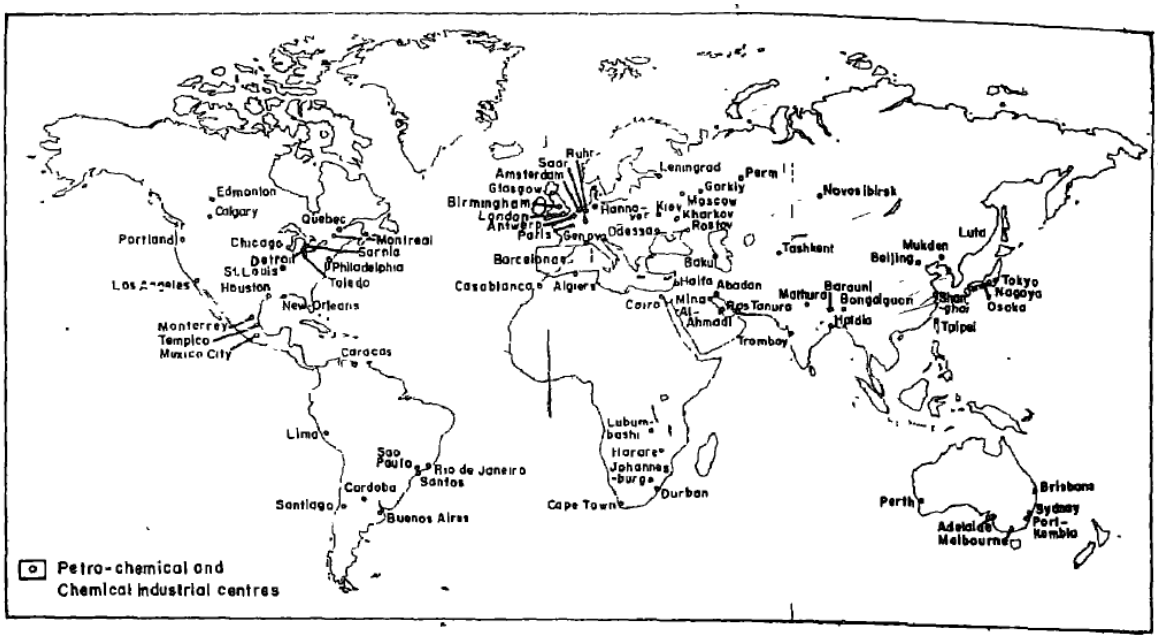


Fig. 10 World-chemical and petrochemical industries

3.2.4. India

The largest petro-chemical complex In India was established by **Union Carbide at Trombay** (Mumbai). A petrochemical complex has been developed along with refinery at **Koeli** in **Vadodra. Indian Petro Chemical Corporation** has been established under public sector. It has started a petrochemical complex at **Jawahar Nagar near Vadodara**. **Bongaigaon in Assam** is another petro-chemical complex under the public sector. **Haldia** (West Bengal) and **Barauni** (Bihar) have been established for petro-chemical processing.

Three large fertiliser complexes are being developed at **Bijaipur, Sawai Madhopur and Jagdishpur** by utilising the gas brought through HBJ (Hazira-Bijaipur-Jagdishpur) pipelines. The **Mathura refinery** has started diversification of products besides refining the oil.

3.3. Textile Industry

History of industrial development in Japan, India, Brazil and Egypt started with the development of the textile industry. The raw material for textile industry is obtained from hair of animals and vegetation. Wool, silk, cotton and flax etc. are raw materials derived from natural sources. Some raw materials for textile industry have been developed by man using his technological and scientific knowledge e.g. nylon, rayon, terelene, terewool, etc.

The technology for manufacturing synthetic fibres has been developed by economically developed countries and therefore, they have monopolised the production of these fibres.

United States of America is an important producer of synthetic fibres. **Here this industry is located in eastern Pennsylvania and mid-eastern Atlantic coastal region**. **Recently it has been developed in Virginia and Tennessee states as they have plenty of water and energy resources, besides the reserves of coal**. **The major synthetic fibre producing countries in Europe are Germany, United Kingdom, Italy, France, Netherlands, Switzerland and Spain**. These countries import the pulp from Norway, Sweden and Finland.

Japan like United States of America is an important producer of synthetic fibre. **This industry is concentrated along with the chemical industry in southern Honshu, Kyushu and Shikoku islands.** The softwood from the **Taiga conical forest belt in Russia** is an asset to the synthetic fibre industry. This industry is concentrated in the western and mid-northern parts of Ural industrial region because this region lies at the meeting point of chemical industry and the conical forest belt.

Student Notes:

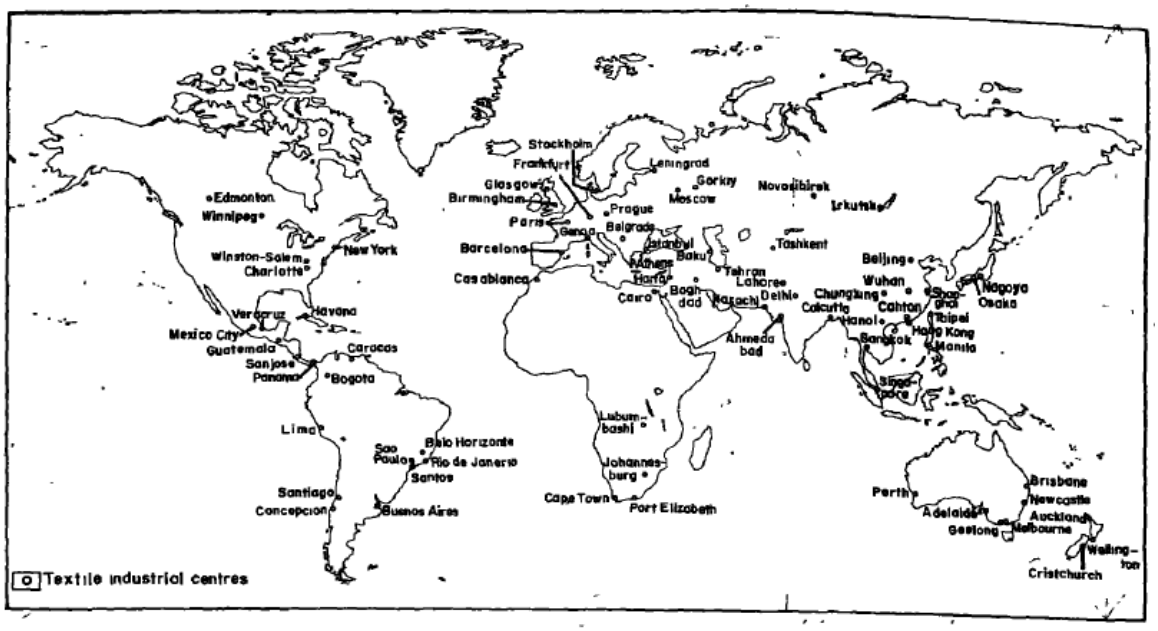


Fig. 11 World-textile industry

4. UPSC Prelim Previous Year Question

1. Which of the following is the chief characteristic of 'mixed farming'? (2012)
(a) Cultivation of both cash crops and food crops.
(b) Cultivation of two or more crops in the same field.
(c) Rearing of animals and cultivation of crops together.
(d) None of the above.

2. In India, the steel production industry requires the import of (2015)
(a) saltpetre (b) rock phosphate
(c) coking coal (d) All of the above

3. Steel slag can be the material for which of the following? (2020)
1. Construction of base road
2. Improvement of agricultural soil
3. Production of cement

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

5. UPSC Mains Previous Year Question

1. Do you agree that there is a growing trend of opening new sugar mills in the Southern states of India? Discuss with justification. (2013)
2. Analyze the factors for highly decentralized cotton textile industry in India. (2013)
3. Account for the change in the spatial pattern of the Iron and Steel industry in the world. (2014)
4. What is the significance of Industrial Corridors in India? Identify industrial corridors, explain their main characteristics. (2018)
5. Discuss the factors for localization of agro-based food processing industries of North-West India. (2019)

6. Vision IAS Previous Years Mains Questions

Student Notes:

1. Temperate regions are more favorable for fishing in comparison to tropical regions. Explain.

Approach:

- Briefly describe the scenario of tropical and temperate fishing.
- Mention the factors responsible for favouring temperate regions in this aspect.
- Conclude on the basis of the above points.

Answer:

Tropical regions are confined between 30° North and South of the Equator and temperate regions extend just beyond the tropical regions and go up to polar areas. Temperate regions are more favourable for fishing in comparison to tropical regions both in terms of quality and quantity of fishing.

The following factors are responsible for this:

- **Presence of continental shelves:** Best fishing grounds are found above continental shelves, where plankton of all kinds are abundant. Such extensive continental shelves are located in higher or mid-latitudes in the northern hemisphere e.g. the banks off Newfoundland, the North Sea etc.
- **Shape of coastlines:** In temperate regions, the coastlines are more indented and are backed by strong relief such as sheltered inlets and estuarine coasts that make ideal sites for fishing ports and villages.
- **Ocean current circulation: Mixing of cold and warm currents** leading to upwelling occurs here which results in plankton growth and consequently provide excellent breeding ground for fishes. Some examples of major fishing grounds include Grand Banks off Newfoundland where the cold Labrador current meets warm Gulf Stream and the region near Hokkaido in Japan where the cold Oyashio current meets warm Kuroshio current.
- **Commercial exploitation:** Fishing is more economical in higher latitudes because in tropical waters fishes are found in multiple varieties of breeds which are not suitable for scalable commercial exploitation.
- **Developed economies:** Commercial fishing industry requires high capital investment, preservation facilities and hence it is well established in developed countries, which are mainly located in higher latitudes.
- **Better properties:** Nutrient content of high latitude fishes is greater than the tropics. Also, the shelf life of fish in tropical climates is lower and there is high oil content in the fish affecting their taste and commercial value.

Apart from the above major factors, skilled fishermen, better transportation facilities, traditionally developed commercial fishing industry due to lack of alternative protein sources also make the temperate regions more favourable for fishing in comparison to tropical regions.

2. Explain the reasons behind development of horticulture and wine industry in the Mediterranean region.

Approach:

- Briefly discuss about Mediterranean agriculture in the introduction.
- Mention the factors responsible for development of horticulture in the region.
- Discuss the reasons for the development of the wine industry in the region.
- Conclude appropriately.

Answer:

Student Notes:

Mediterranean regions, also known as the **'orchards of the world',** have well developed viticulture and horticulture industries. A wide range of citrus fruits such as oranges, lemons, limes, citrons and grapefruit are grown here. It accounts for **70 per cent of the world's exports of citrus fruits.** In addition to growing fruits, the region is significant for fruit cultivation, cereal growing, wine making and agricultural industries. There are numerous factors that make the region the **hub of horticulture**. **They are:**

- **Suitable climate**: The Mediterranean climate is best suited for growing fruits and vegetables due to the following:
  - Warm bright summers and cool moist winters enable a wide range of fruits to be produced.
  - Warm temperature ensures a fairly long growing season.
  - Long, sunny summer enables the fruits to be ripened and harvested. Dry summer is favourable for fruit processing and drying.
- **Adaptability of plants:**
  - Fruit trees have long roots to draw water from considerable depths during long summer drought.
  - Thick, leathery skin of citrus fruits prevents excessive transpiration.
  - Olive trees can survive on very poor limestone soils with less than 10 inches of annual rainfall.
- **Irrigational infrastructure**: In some regions such as the Great Valley of California, the Vale of Chile, the Negev Desert of Israel, there exists an **elaborate system of irrigation canals** that enables both fruits and cereals to be successfully raised.
- **Fertile soil**: Soils are not excessively leached and therefore are fairly fertile.

The region also produces some of the **best quality wines with distinctive tastes**, making it the **global hub of the wine industry**. The following **factors** can be attributed to this:

- **Historical factors**: Viticulture is a Mediterranean occupation by tradition and the regions bordering the Mediterranean Sea account for **three-quarters of the world's production of wine**.
- **Local demand:** In most of the Mediterranean countries such as Spain, France, Italy and Portugal, wine forms an important part of daily food habits. The average wine consumption of the Mediterranean countries is about 15 gallons per head per annum. Thus, high **local demand** also contributes to the growth of the wine industry.
- **Availability of raw material:** The long sunny summers allows grapes to ripen. Wine industry is dependent on production of grapes. About 85% of grapes that are grown here, goes into wine making.
- **Geo–climatic factors:** The quality of fermented grape juice is decided by a number of factors including types of vines grown, the quality of the soil, the climate of the region, the method and extent of the fermentation. The Mediterranean climate is favourable in these aspects.
- **Marketing**: To maintain exclusivity, principal wine areas maintain different names. The wine from South Spain is called Sherry, from Portugal, Port Wine etc. In France, the greatest wine regions are located further north e.g. *Champagne* in the Paris basin, *Bordeaux* in the Garonne basin and *Burgundy* in the Rhone -Saone valley.

Thus, various factors ranging from climatic to historical have helped in the development of horticulture and wine industries in the Mediterranean region.

Student Notes:

3. Identify the characteristics of commercial livestock rearing and mark the regions practicing it on a world map. Also, discuss its challenges and opportunities in context of India.

Approach:

- Explain the meaning of commercial livestock farming briefly and highlight its basic characteristics.
- Show its geographical spread preferably on a world map.
- Discuss the challenges and opportunities of this sector for India.

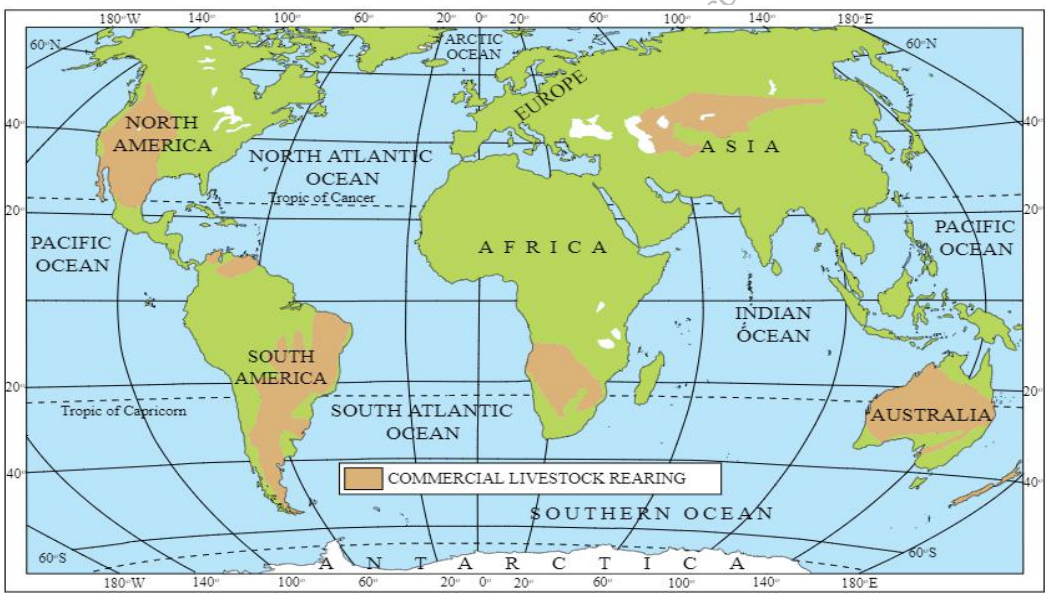
Answer:

Commercial livestock rearing is a practice wherein animals are used to produce labour and commodities such as meat, leather and wool.

Main characteristics

- It is organized and capital intensive.
- It is essentially associated with western cultures and is practiced on permanent ranches.
- Number of animals in a pasture is kept according to the carrying capacity of the pasture.
- It is a specialized activity in which only one type of animal is reared. Important animals include sheep, cattle, goats and horses.
- Products such as meat, wool, hides and skin are processed and packed scientifically and exported to different world markets.
- Rearing of animals in ranching is organized on a scientific basis.
- Main emphasis is on breeding, genetic improvement, disease control and health care of the animals.

New Zealand, Australia, Argentina, Uruguay and United States of America are important countries where commercial livestock rearing is practiced. The world map below highlights the important regions



Livestock in India: Around 20 million people are dependent on livestock sector for their livelihood.

Challenges

- Improving genetic resources in cattle and overcoming livestock diseases.

- Small size of herds in most parts of the country
- Livestock continues to be raised on crop residues and agricultural by-products. The area under cultivated fodder production is limited only to 4.60% of the total cultivable land.
- Disease diagnosis, health and hygiene maintenance of are affecting the production potential.
- Availability of quality nutrients through feed and fodder resources.
- Mitigating the issue of greenhouse gas emissions contributed by livestock.

Opportunities

- Growing demand for animal food products is an opportunity for the poor to escape poverty through diversifying livestock production.
- Greater integration of global markets under World Trade Organization (WTO) provides opportunities for exporting animal food products.
- With fragmentation of land, livestock presents an opportunity to the small landholders.
- Livestock rearing provides an escape route from the climate vagaries.

The extent to which the India expropriates benefits of emerging opportunities would depend on how policies, institutions and technologies address the constraints.

4. Industries are not evenly distributed in the country. They tend to concentrate on certain locations because of the favourable locational factors. Elaborate with the help of examples of industrial regions in India.

Approach:

- Briefly introduce the factors responsible for the location of factories.
- Explain every factor along with the relevant example for the location of industries in India.
- Conclude while giving the contemporary view of the factors which influence the location of industries.

Answer:

There are various factors which affect the location of industries such as the availability of raw material, land, water, labour, power, capital, transport and market etc. Industries are situated where some or all of these factors are easily available.

Factors responsible for uneven distribution of the Indian industries are:

1. **Raw Material:**
   - The industries in India developed near the sources of raw material, such as, the textile mills in Bombay get their supply of cotton from Gujarat and Vidarbha and the jute mills of Hooghly region got the raw material from the delta region of the Ganga.
   - Raw materials which get reduced in weight (perishable) influence the industry to be located near the source such as location of sugar mills in Maharashtra and western Uttar Pradesh and of iron and steel industry in West Bengal-Bihar-Orissa belt.
2. **Energy:**
   - The iron and steel industry which uses coking coal for fuel has been traditionally located near the coal resources.

Student Notes:

- Similarly, the electro- metallurgical and electro-chemical industries have been located where electricity is easily available. E.g.: aluminum producing units at Korba and Renukoot in Madhya Pradesh and fertiliser plant at Nangal in Punjab.
- However, these industries can also be dispersed to places where electricity and petroleum can be transported. E.g. coal deficient peninsular region.

3. **Transport:**
   Industries are developed near the port towns of Kolkata, Mumbai and Chennai, since these ports were linked with rail and road to hinterland.
4. **Labour:**
   The availability of both unskilled and skilled, or technically manpower is an important factor in the location of industries. The industrial belt around Mumbai attracts labour from all over the country, glasswork (Ferozabad), brass-work (Moradabad), utensils (Yamunanagar in Haryana), silk sarees (Varanasi), carpets (Mirzapur), etc.
5. **Water:**
   Industries which heavily depend on water, for one purpose or the other, include iron and steel (for cooling), textile (for bleaching and washing), paper and pulp etc. are located at places where water is easily available. Ex: textile industries in Maharashtra, leather industry around Kanpur (UP), etc.
6. **Market:**
   High demand and a satisfactory purchasing power give impetus to industrial development. Market may be local, national or international.
7. **Agglomeration** concentrates many firms into industrial regions or zones sharing specialized input factors to realize monetary benefits.
8. **Other factors:**
   Sometimes government policies for various purposes influence the location of industries, such as to promote regional parity by locating the industry in backward regions they give incentives such as subsidised power, lower transport cost and other infrastructure. For instance, oil refinery in Mathura, a coach factory in Kapurthala etc.

With scientific and technological advancement, the geographical factors have not remained rigid. Now, labour has become more mobile, long distance transmission of energy is possible now and alternatives of various raw materials are available. Therefore, these new factors have also come into play while deciding the location of an industry.

5. Give an account of the geographical distribution pattern of major agro-based industries in India. Also, explain their multiplier effect on rural economy.

Approach:

- Briefly, describe the agro-based industries in India and their significance.
- Bring out the geographical distribution pattern of major agro-based industries in India.
- Explain its multiplier effect on rural economy.

Answer:

Agro-based industry in India is largely unorganised but contributes significantly to agri-GDP, employment and income. The geographical factors like topography, climate, soil and human resources play a dominant role in establishing and developing agro-based industries. Broadly, agri goods are perishable and also industry is weight-losing in nature, and hence, agro-based industry is mostly located near to the source of raw-material. The major agro-based industries and their distribution patterns are as follows:

Student Notes:

- **Cotton Industry**: Raw cotton is extracted for fibre, which is converted into yarn, which is then used in cotton based textile and other industry. Fibre is usually extracted near the source whereas yarn is produced nearer to the market (i.e. textile industry). Mumbai, Coimbatore, Panipat are important centres. Textile industry is dependent on transport and is spread out in states like Gujarat, Punjab, Karnataka, AP, etc.
- **Jute Industry**: Major jute growing areas are located in West Bengal along the Hoogly River, which led to the concentration of Jute industry in West Bengal.
- **Sugar Industry**: Due to weight-losing nature of sugarcane, it cannot be stored for long. Therefore, sugar industries are located in proximity to sugarcane growing areas. In India, around 70% of total sugar production is generated from Uttar Pradesh, Maharashtra and Tamil Nadu.
- **Vegetable Oil Industry**: Different regions use different raw materials and use different technology to extract oil. Also, the size of units differs from place to place. These are widely scattered in Maharashtra, Gujarat, Uttar Pradesh, West Bengal, Karnataka, Tamil Nadu, etc.
- **Tea Industry**: Major tea growing areas are located in Assam, West Bengal, Tamil Nadu, Kerala and Karnataka. Therefore, nearly 98 per cent of the tea is produced by these states.
- **Coffee Industry**: More than half of the country's coffee production comes from Karnataka (Coorg and Chikmagalur districts). In Kerala, coffee production is concentrated in Wayanad, Kozhikode and Cannanore. In Tamil Nadu, it is located in Nilgiris, Annamalai, Shevaroy hills, Palani hills, Tirunelveli and Madurai.
- **Silk Textiles:** Sericulture is a labour-intensive industry. Major silk growing areas are located in Karnataka (Tumkur, Dodballapur, Bengaluru), Andhra Pradesh (Karimnagar, Warangal, Mahbubnagar), Tamil Nadu (Dharmapuri, Salem, Coimba-tore), Bihar (Katihar, Bhagalpur), West Bengal (Malda, Murshidabad, Bankura), Assam (Kamrup, Dibrugarh, Sibsagar and Jorhat), etc.

Student Notes:

These agro based industries can have a multiplier effect on the rural economy in the following manner:

- **Employment generation:** Unskilled agri-labour can be productively employed with little skilling in agri-based industry. It will control rural migration.
- **Increase in farmer income:** Farmers are able to get a greater share in value of final goods if they sell directly to the industry v/s when they sell via middlemen.
- **Boost to rural economy:** Upliftment of rural economy by generating income and improving the standard of living.
- **Decentralization and dispersal of industries** to different areas, therefore, ensuring the development of backward areas.
- **Reduce disparity** between rural and urban areas and encourages **balanced regional development**.
- Ensure timely supply of perishable raw material to industries, therefore, **avoid farm produce** loss of farmers.
- Gives a big push to agriculture and acts as a source of demand and supply and improve infrastructural facilities.
- Develop synergy between agriculture and industry, therefore, ensuing balanced growth between agriculture and industry.

Thus, it is apt to say that agro-based based industries can play a crucial role in harnessing the full potential of the rural economy.

VISIONIAS
INSPIRING INNOVATION

7 IN TOP 10 SELECTIONS IN CSE 2019

2 AIR

JATIN KISHORE

3 AIR

PRATIBHA VERMA

6 AIR

VISHAKHA YADAV

7 AIR

GANESH KUMAR BASKAR

8 AIR

ABHISHEK SARAF

9 AIR

RAVI JAIN

10 AIR

SANJITA MOHAPATRA

9 IN TOP 10 SELECTIONS IN CSE 2018

1 AIR

KANISHAK KATARIA

2 AIR

AKSHAT JAIN

3 AIR

JUNAID AHMAD

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