India is physically divided into 5 parts:

1. ***Himalayan Region***
2. ***Great Plains of Northern India (Desert & Northern plains)***
3. ***Peninsular India***
4. ***Coastal plains***
5. ***The Islands***

1. HIMALAYAN REGION:

- These are the higheset peaks of the world.
- These are lofty and continuous mountains.
- It has an average elevation of 3,050m and extending from Potwar Plateau in Pak to Namcha Bharva in India.
- They are extended to 4,500km. They occupy 5Lakh Sq m
- Width of Himalayas is 500k.m (Jammu and Kashmir) in West and 200K.m in East(Arunachal Pradesh)
- They are extending from Pamir knot towards east. In ancient days Pamir knot (afghan) is called Trishungaparvath. At present it is called “roof of the world”.
- The southern boundary of Himalayas is demarcated clearly with the northern boundaries of the Greatplains.
- The northern part is not clearly demarcated because this part is merging with Tibetan plateau.

➢ Himalayas are very unique in their height, steep gradient, snow capped summit, deep valleys, youthful drainage, complex geological structure with rich temperate flora in subtropics.

ORIGIN OF HIMALAYAS:

O.H.K.Spate, D.N.Wadia, de terra, Patterson, Wager etc., were the prominent who gave the theories and explainations for the origin of Himalayas.

According to them Himalayas are originated from geosyncline of Thethys sea,but they differ in time, factors and process of origin of Himalayas. This has taken place 120 million years ago.

Two sides of Thethys Sea is of angara at one side and gondwana lands on the other side.

Thethys Sea is a shallow sea which was filled with sedimentations and Himalayas originated due to lithification.

3 distinct phases of upliftment

1st phase – 120-70 million years ago where Greater Himalayas were originated.

2nd phase – 30-25 million years ago where the middle Himalayas were uplifted.

3rd phase – 20-2 million years ago where the Shivaliks have come into existence.

The process of formation of Himalayas was started in Cretaceous period of Mesozoic era continued till upper Pleistocene period to recent times.

Godwin Austin – surveyor general of India calculated that before 1 million year ago the average height of Himalayas was 2,440m. but at present are 3050m.

Mt.Everest – 8848m. height according to Chinese trigonometric calculations. 8850m. present height.

Himalayas are rising 5 to 10 cm. every year.

Himalayas are in the form of arcuate curve,whose convexity is pointing towards India due to push offered by Aravallis & Assam hills.

Himalayan region is divided into 3 divisions.

1. Himalayan ranges

2. Trans Himalayas

3. Eastern Himalayas(the Purvanchals)

1. <u>Himalayan ranges:</u>

They are in the form of 3 parallel range of mountains. Among the three, shivaliks are the last one to be formed.

a) Shivaliks are also called as outer or sub Himalayas,they are continuous for 2,400 km. except for a gap of 80-90 km. and this gap is due to Teestha and Raidhak valleys. Width of shivaliks is 150 km in arunachal Pradesh and 50 km. in himachal Pradesh. Average height of shivaliks is 600-1500m.

The deposits from mountains is known as piedmont.

Shivaliks are lithified of river water deposit sloping down the other two mountains.

Duns – in western Himalayas fertile land masses between higher ranges and shivaliks.

Duars – eastern Himalayas.

Shivaliks are called as

1. jammu hills

2. dang or dudwa ranges in uttarakhand

3. churia ghat ranges in Nepal

4. miri, mishmi, azhor in assam.

b) Middle Himalayas or lesser Himalayas or himachals:

They are intricate system of Himalayas with a width of 60-80km. and the average elevations are ranging between 3,500-4,500 m. but there are several peaks above 5000m and are snow capped through out the year.

They are characterized by nappe formation.

The important ranges of middle Himalayas:

1. Pirpanjal, dauladar, mussorie in j&k and H.P.

2. Nag tibha, mahabharath lekh in Nepal.

- Pirpanjals are the important & longest ranges present in j&k. they run for 300-400km.
- They are exending between Jhelum River and river Beas (upper) in the north west to south east directions.
- Pirpanjals are made up of volcanic rocks.
- Their elevations are 5000m.
- Above the pirpanjals are the Kashmir valleys.
- Kashmir valley is between pirpanjal & zhasker.
- Satisar lake left overs are called vales of Kashmir.
  Kashmir vale – 135km length and 45 km in width. They are present at the height of 1585 m.

- Passes of pirpanjals:
  Pirpanjal pass-3480m,
  Bidil pass-4270m,
  Golabahar pass-3812m,
  Banihal pass-2835m.
- Banihal pass connects Srinagar and jammu highway
- The pirpanjals are continued as dauladhar ranges towards their south.
- Dauladhars are southern most extremities of middle Himalayas.
- In dauladhars, some of the peaks hardly exceed 4000m height.
- Dauladhar ranges are going through Dalhousie, dharam shala (exale of Tibet) & shimla.
- The middle Himalayas are more human friendly in nature. Several resorts like shimla, raniketh, nanital, almora, Darjeeling
- miri, mishmi etc., are considered to be parts and parcels of lesser Himalayas.

c) Greater Himalayas or axial Himalayas or inner Himalayas or himadri:

- These are the northern most of Himalayan ranges.
- These are extending from nanga parbath in north west to namcha barua in the north east.
- Average width is 25 km. and the elevation is 6,100m.
- These are the most loftiest and continuous mountains.
- Southern slopes are very steep and the northern slopes are merging with Tibetan plateau.
- These are made of crystalline rocks. (granite & gneisses)-central part.
- They are overlain by metamorphic rocks.
- Mt.Everest is called as ‘sagarmatha’ in Nepal which means ‘goddess of sky’.
- In Tibet it is called chomolangmo.
- In china, zhumalangma- mother of world.
- Sewalangma in Sikkim which means 5 treasures of snow.
- Makalu peak-8481m. in height
- Daulagiri peak – 8172m.
- These Himalayas are hostile in nature.
- Passes:

Zozilla-connects ladakh &Srinagar highway

Burzil- Srinagar & gilghit highway

Shipkila- shimla with gartok- it is called as Hindustan Tibet road.

Baralachala – lahul (H.P.) with Ladakh

Jelepla – kalimpong with Lhasa (Tibet)

2. Trans Himalayas:

- They are also called as Tibetan or thethian Himalayas.
- Length-1000km with an average height of 3000m.
- The width towards the extremities is 40 km but in the middle it is 225 km.
- They consist of karakoram ranges, ladakh ranges, Zaskar ranges and Kailas ranges.

1. Karakoram ranges:

Karakorams are northern most boundaries and they act as watershed between Indus and tharim (china).

- Mass wasting: Any downhill movement under their own gravity. Ex: landslide- sudden movement of sands, rocks.
- Average elevation of karakorams is 5,500m and their width is 120-140 km.
- K2 is the highest peak of karakoram which is under POK. K2-8611m-Godwin Austin, Chinese call it as qogir, Balti people call it chogori (big mountain).
- Gosherbum is the 2nd highest peak with a height of 8068m.
- Karakorams have biggest glaciers. They are the abodes of largest glaciers in the world other than polar and sub Polar Regions like Siachen, Baltoro, Biato, Hisper remu.
- North east of karakorams lies the ladakh plateau.
- Ladakh plateau is dissected into several plains. (aksaichin, soda, lingzitang, depsang, changchenmo)
- Ladakh is a cold desert.
  Desert: an area receiving lesser than 12 cm. of rainfall annually.

2. Ladakh ranges:

- They run parallel to karakorams to a distance of 300 km. with an average elevation of 5,800 m.
- The extensions are in the form of kakaposhi & haramosh. They are extended beyond Indus valley.

- Indus river is antecedent, present prior to the upliftment of area.

Kailas ranges:

- Extensions of ladakh in the western Tibet.
- They are called as gangdise in Chinese.
- The average height of Kailas ranges between 5,500m to 6000m. and width is 30 km.

Zaskar ranges:

- Branching off from the greater Himalayas at 80^{o} east and are moving north ward parallel to ladakh ranges.
- Nanga parbat is the culmination of zaskers.
- Deodesais are the extensions of zaskers.

Peaks of Zaskar ranges- kamat, nandadevi & gurla mandhata etc.,

Eastern Himalayas or purvanchals:

- Max.avg height is 3000m.
- Densely forested hill ranges.
- Southern slopes are favourable for vegetation because of abundance of sunlight than northern.
- Indus sancho suture zone-brahmaputra is flowing suturing of is flowing suturing of angara & gondwana.
- Mishmi & patkaibhum are together called purvu-NEFA.
- The highest ranges of eastern Himalayas are present in mishmi hills.
- Patkai bhum will be merging with naga hills-2500m.
- Daphabum-4758m height- highest peak.
- Patkai bhum act as water divide between arunachal Pradesh & Myanmar.
- Mt.Saramathi-3826m.- heighest peak in naga hills.
- Left of naga hills are the kohima hills.
- Kohima hills show ridge & valley topography (steep gradient & deep valleys)
- Japvo is the highest peak in naga hills.
- Tuesang hills – northern most extension of Manipur hills.
- Manipur hills have centripetal drainage in the midst where all the streams meet at depressions. That area is called loktak lake.
- In the south west of the tusang are the burail ranges.
- Burail ranges act as dividing line between Meghalaya plateau &

purvanchals.

- Manipur hills will be merging with mizohills.
- Mizohills are recenty called as lushai hills.
- Blue mountain is the highest peak in mizohills.
- The height of purvanchals is max. towards north & decreasing towards south.
- Mizo hills will be entering into the Myanmar in the form of arkanyama ranges.
- The purvanchals will be merging in the bay of Bengal and arise as Andaman & nicobar islands.

Regional divisions of Himalayas:

- Sir Sydney Burard gave realistic division of Himalayas. Based on river valley, Himalayas are divided into 4.

1. Punjab Himalayas: They extend for 560 km between Indus & Sutlej rivers. These are also called as himachal and jammu Himalayas. Karakoram,ladakh, pirpanjals, zaskars and dauladhars are the important ranges in this. Their general slopes are towards west.

2. Kumaon Himalayas: They run between Sutlej and kali river for 320 km. the western parts of kumaon Himalayas are called gharwal ranges. The eastern parts are called kumaon propers. Peaks like nandadevi, trishul, badrinath, kedarnath, gangotri etc.,

3. Nepal Himalayas: They run between kali and teestha for 800km. These ranges boast the highest peaks of the world.

4. Assam Himalayas: They extend for 750km between teestha and Brahmaputra. They occupy larger parts of Sikkim, arunachal Pradesh and assam.

- Western Himalayas are from Indus to kali.
- Eastern Himalayas are from langlila ranges to Brahmaputra.

GLACIERS:

- Out of 5 lakh sq.km, 33,000sq.km of Himalayas is covered with glaciers.
- In the Sikkim, the snow line is at a height around 3965m.
- In the lahul and gharwal, the snow line will be descending to 3660m.
- In karakorams it is 2500m

- I.D.La Touche variation of the snow lines because of the latitudinal variations snowline varied from karakorams to Sikkim.
- 16,000 sq.km of area in the karakorams is snowbound.
- Siachen is the largest glacier present in karakorams.
- Siachen (75km long) is present in nurba valley.
- Nurba valley is the only way to enter the siachen for our soldiers.
- Some other glaciers in karakorams are fedchanko, biofo, remu, baltara, hisper etc.,

Glaciers of pirpanjals:

- Smaller in size & lesser in number.
- The biggest glacier in pirpanjals is sonapani which is 15-16km long.
- This is present in Chandra valley (H.P).

Glaciers of kumaon Himalayas:

- The biggest glacier is the gangotri glacier which is 30 km long. From satellite images, they revealed that they receded from 30 to 22 km.

Glaciers of gharwals:

Mana, milam, bhagirath karak, satopanch, sankalp, raikane.

Nepal's glaciers:

- Yepokanga glacier of gosainthan mountains.
- Ledanda and chhuling in masasoles.

Glaciers of Kanchenjunga:

Rongbuk, khumbu, jhemu, yalung, alukthang, barun etc.,

SIGNIFICANCE OF HIMALAYAS:

- These are the body and soul of India. They have carved the destiny of India. They are significant in many ways.

1. Climatic significance: They act as orographic barriers to monsoons. They obstruct cold winds from Siberia.

2. Defense: These have defended India from foreign invasions for longer time but the Chinese aggression has reduced its significance (1962).

3. Source of river: All the great rivers of India have their sources here.

4. Fertile soils: The great plains of north India are the gifts of Himalayas. Alluvial plains every year around 9 lakh tons of silt is carried by Indus and Brahmaputra will be carrying much more than 12 lakh tons. Because of the excess silt it is called slow moving lake.

5. Hydroelectric potential: The disturbances caused in the Himalayas are called isostatic disturbances. The vast potential still awaits proper exploitation.

6. Forest wealth: The Himalayas shows the succession of forests from tropical to sub tropical to temperate to boreal (needle leafed favorable for less transpiration and frost bite). These plants are helpful for industries and herbs are used for medicinal purpose.

7. Agriculture: It is in the form of terrace farming and rice is the main crop cultivated there. Tea & saffron are unique to Himalayas. Wide varieties of fruits are cultivated here (apples, pears, walnuts, cherries etc.,)

8. Tourism: Himalayas are scenically very beautiful. By virtue of its beauty, the tourists from worldwide visit there. Many of the places are virgin. Tourist spots are Srinagar, dalhouie, dharamshala, shamba, shimla, kulu, manali, mussorie, nanithal, almora, Darjeeling etc.,

9. Piligrimage: The entire Himalayas are studded with sanctified shrines. They are considered to be abodes of the gods. Important shrines are kedarnath, badrinath, amarnath, vaishnodevi, jwalaji, gangothri, yamunotri and Kailas.

10. Minerals: Himalayas contain many commercially valuable minerals but unfortunately we cannot exploit them with the present day technology because the geological and geographical conditions are not favorable. Himalayas are called as ‘museum of minerals’.

2. GREAT PLAINS OF INDIA:

- To the south of Himalayas and to the north of the peninsular india lies the great plains.
- The great plains of India are the one of the biggest alluvial traces of the world.
- They extend for a length of 3,200km of which 2,400km are present in india.

- The total area covered by the Great Plains is 7.8 lakh sq.km with an average width of 150 to 300 km. and towards the west the width is 500 km at rajasthan. At Allahabad is 280 km at rajamahals, it is 160 km and in Bengal is 460 km. in Assam it is 60-80 km.
- The average depth of the alluvial deposition is ranging between 1500-2000m. and in many of the areas the depth is more than 5000 m. `

Important locations:

- Meerut – 1066.8m
- Kalyan – 2286m
- Dehradun – 5123.8m
- Siliguri – 5577.8 m

The average elevation is only 200m above the mean sea level.

Max. elevation is 291m present between ambala and Saharan pur.

Ambala is in the Punjab-haryana area and Saharanpur is in uttarakhand.

The plains are a water divide between Indus and ganga water systems.

The average gradient from Saharanpur to Kolkata for 1500km is only 20 cm per km. because of this they are called as greater plains on the earth.

Origin of greater plains:

The depositions into one depression created the greater plains where the rivers got sedimented.

Two theories contended till recent.

1. Edward suess's foredeep theory

2. Sir Sydney Burard's rift valley theory

The foredeep's theory says that the foredeep formed at the foot of the Himalayas got filled with the silt.

The rift valley theory says that a rift valley was formed as a depression between the Himalayas and the peninsular plateau, but discoveries prove that there is no rift (=break) present.

Many of them thought that great plains are monsoons without any differences

but they are formed of different stones, sand etc.,

The plains of north India are divided into 4 parts.

Geomorphology of plains:

There is a tendency amongst the geographers to treat the plains as monotonous, flat and featureless plains. But it has its own geomorphological variations like

Bhabhar: This is a narrow belt of about 8-16km along the foot hills of shivaliks continuous from theestha to Indus river. It is a piedmont plain which is pebble studded sediment and consists of gravel and unsorted sediments where many streams disappear and flow under the rocks.

Terai: It is the 15-30 km wide marshy tract to the south of bhabhar where the re-emergence of the rivers takes place. Because the area has excess of dampness it is covered with thick forests and variety of wildlife most of it is reclaimed for agricultural purposes.

Bhangar: It is composed of older alluvium above the level of flood plains. It is often impregnated with calcareous concretions called kankar.

Khader: This is the belt composed of newer alluvium and forms the lowline flood plains adjacent to the river banks. Most nutritious because of the mineral contents in the form of silt.

- Bhangar is the interflew area .
- ➢ Interflew- high rised area above the food plains.
- ➢ Low lined area is the flood prone area.

Regional division of plains:

They regionally divided into

1. Rajasthan plains:

- These are called as sindh plains in Pakistan. Dhoros are the recently deposited alluvial clay and sands in sindh.
- Dhands: The alkaline lakes present in the dry courses of the rivers are called dhands.
- Pattis: These are the longitudinal depressions between the sandy hills.
- Rajasthamn plains are western most extremities of the Great Plains.

- They consist of Thar Desert.
- The length is 650 m. and the width is ranging between 250-300 km. The area occupied by this is 1.75 lakh sq.km (0.25 lakh sq.km in pak) with an average elevation of 325 m. but towards the south (ran of kutchch) it is 150 m.
- The desert proper in rajasthan is called as marusthali.
- Dhrian- the shifting sand dunes.
- Thali-These are the sandy plains present towards north of luni river.
- Salt lakes are present in thar desert.
- Playas- The depressions into which depositions occur.
- Sars- Salt soaked playa lakes are the sars.
- Salt lake- If the sars become permanent, they are called as salt lakes.
- Sambar is the biggest salt lake in india.
- Didwana, tegana, kuchaman, sargol, kathu, are the other salt lakes.
- Some of the grasslands present in rajasthan are called as bagar.
- Bagar- steppe vegetation form of grasslands.
- Fertile tracks present in rajasthan plains are called as rohi.
- Khatara depression in sahara is 450 ft. below the sea level.

2.Punjab - Haryana plains: They extend to a length of 640km. from north east to south west direction. In the east-west direction they extend for 330km. and from north-south is 600 km. The total area covered is 1.75 lakh sq.km. The average elevation is 250 m. and the plains are formed due to the depositions of 5 rivers.

The land between two of the rivers is called doab.

From east to west the doabs are

i. Bist-jalandhar doab between bias and Sutlej.
ii. Bari doab between beas and ravi
iii. Rechana doab between ravi and Chenab.
iv. Chaj doab between Chenab and Jhelum
v. Sindh sagar doab between Chenab, Jhelum and Indus.

These 5 rivers are together join at panjnad.

3. Ganga plains:

This consists of the largest unit of Great Plains covering an area of 3.75 lakh sq.km. This is formed due to the contributions made by both Himalayan and peninsular rivers.

They are further divided into

a. Upper ganga plain: It is about 550 km. in length and 380 km. in width covering an area of 1.49 lakh sq.km. Elevation varies from 100 to 300 m and the average gradient is 25 cm/km. with many meandering rivers.

b. Middle ganga plains: This occupies parts of UP, Bihar, Jharkhand for 600 km in length and 330km in width. The total area covered is 1.44 lakh sq.km. The gradient is very steep. It will be touching to 45 cm/km. The sorrows of Bihar i.e., kosi causes devastating floods in this region.

c. Lower Ganga plains: This is present in parts of Jharkhand, W.B, Bangladesh and is about 580 km in north south extent and 200 km in east west extent.

- It covers an area of 81,000 sq.km.
- This is the most flat surface of indo gangetic plains.
- These have a gradient of 2cm/km.

Large parts of its coastal delta is covered by tidal forests called sundarbans.

The ganga plains are divided into four shelf areas by three transverse highs or buried ridges.

They are:

1. The delhi-haridwar: This is running in south-western to north eastern direction from delhi to garwal range.

2. Sharadar depression: This is a depression formed by the river sharadar adjacent to delhi-haridwar ridge.

3. Western U.P shelf: This is a shallow shelf present in between sharadar depression and faizabad ridge.

4. Faizabad ridge: This runs in a curved manner from Allahabad to Kanpur and then to luckow and into the Nepal.

5. Ghandak depression: This depression is travesed by river ghande which is entering from Nepal.

6. Eastern U.P shelf: The shelf area towards west of munger-shaharsa ridge is the eastern U.P Shelf.

7. Mungiar-shaharsa ridge: This ridge runs from the mungiar of bihar sharif

towards shaharsa and enters into eastern Nepal near morang.

Recently some faults in this areas have been identified

Faults:

Moriabad fault and bhairawan fault are found near vicinity of Allahabad.

Western patna faults: It runs from arrah in the south bihar to nepalis border i.e., east of madhu bani ranges.

Delhi-muzaffer nagar ridge: This is running in east west direction from Delhi and enters Nepal at kathgodam.

Terms related to plains:

Khols- these are the intervening slopes of old bhangar plains.

Bur- this is an elevated area flanking the rivers on both sides.

Caurs-these are the long lines of marshes extending parallel to ganga.

4. Brahmaputra plains- These are also called as Assam plains. They extend for 720 km from sadiya to dubri. Width is 60-100km, covering an area of 56,000 sq.km and this runs from sadiya to dubri with an average gradient of 12cm/km. Brahmaputra plains consists of large marshy tracts.

Significance of plains:

The granary of India:

The fertile alluvial soils, the flat surface and the slow moving perennial rivers with favorable climate have made the northern plains to be the granaries of India.

Transportation network:

Except the Thar Desert the entire plain area has a close network of railways and roadways. This led to large scale industrialization and urbanization.

Religion:

There are many religious places dotted and many religions flourished here like Buddhism, Jainism, bhaktism, Sufism etc., In short the vast plain of north india is the heart throb and constitute the very soul of india.

3. Peninsular India or plateau:

It is roughly triangular in shape with apex forming at kanyakumari. The plateau covers an area of 16 lakh sq.km which is half of the total land area of the country. The northern boundary is irregular line running from kutchch and then roughly parallel to the aravallis and ganga-yamuna plains till rajmahal hills. This is the largest physiographic division of India and average elevation is ranging between 600-900m. The general slope is from west to east. But the close observations show three slopes i.e., the narmada-tapti rift slopes towards west and north of vindhyas slopes towards north. The plateau is consisting of Archean schist and gneisses (degraded granite). The peninsular plateau is a stable shield where only areal and sub areal processes have worked incessently. Hence called as craton. This plateau is an aggregation of several smaller plateaus, hill ranges, river basins and valleys.

The plateaus of peninsula:

1. The marwar upland: It is present in rajasthan falling eastwards of aravallis in the jodhpur region. It is made up of sand stones, shale and limestones of vindhyan period.

2. Madhya bharath patthar or central uplands: The central upland is present in M.P. It consists of old rocks interspersed with rounded hills composed of sand stones. To the north of it the ravine formations with thick forests are present. It is traversed by sindh and Parbath Rivers (tributaries of Chambal).

3. Bundel khand: It extends between M.P & U.P. and present to the south of Yamuna between the Madhya bharath patthar & the vindhyas. This is an old dissected upland consists of granite & gneisses. It slopes towards north and it is rendered unfit for cultivation.

4. Malwa plateau: Present in M.P. & Rajasthan. It forms a triangle with aravallis on the west, bundelkhand on the east and the base with vindhyas. It is drained by Chambal and its tributaries.

5. Bhagel khand: Also called as vindhyachal plateau present in M.P & chattisgarh to the north east of maikala ranges the plateau is present and made up of limestone & sand stone on the west and granite on the east. The north is bounded by Sone River and the south is having highlands and valleys made up of limestones. The central portion acts as a watershed between the sone and the Mahanadi River systems.

6. Chota Nagpur plateau: To the east of bhagel khand is the CNP which

represents the north eastern projections of the Indian peninsula. This is extending into northern chattisgarh, Jharkhand and purulia of W.B. Average elevation of 700m and it is mainly composed of gondwana rocks of granites, gneisses and Deccan lava. The highest general elevation is 1100m known as patlands representing a radial drainage pattern (damodar, subarna rekha, north&south koel, barker). The river damodar flows through the middle, in the rift valley with gondwana coal fields. North of river damodar is called the hazaribagh plateau with an average height of 600m having isolated hills where parasnath is the highest peak with 1366m. The area is made up of granites and gneisses while the hills have quartz rocks. South of it is the Ranchi plateau also having an elevation of 600m. Towards its western part steeply risen messas with laterites are present. Goru rice (1142m.) is the highest. Rajmahal hills form north eastern edge of chota Nagpur plateau in Jharkhand mostly made up of basalt and they run in north-south direction with an average height of 400m.

7. Meghalaya plateau: The rocks of the peninsular plateau extend further northeast in the form of rectangular block known as Meghalaya or the shillong plateau. The gap between the main plateau and this is called malda gap or the garo rajmahal gap which was formed by the down faulting and was later filled by the sedimentations from the Ganga. It covers 35,000sq.km formed by Dharwarian quartzites, shales, schists and granite intrusions. It slopes to north into the Brahmaputra valley and south into the surma and meghna valleys. Its western boundary coincides with the Bangladesh border. This plateau is made up of garo hills in the west, kasi in the middle and jantia to the east. Shillong is the highest point with an elevation of 1961m and Kailas peak in the garo hills is the highest (1026m.)

8. The Deccan plateau: It is the largest unit of the peninsular India covering an area of 5 lakh sq.km. This is bounded by hill ranges on all the three sides. To the west the Western Ghats, to the east, the Eastern Ghats and to the north are satpura, vindhya, kaimur etc., It is having an average elevation of 600. 1000m to the south and 500m to the north. Major rivers like Mahanadi, Godavari, Krishna, Cauvery etc., flow through this plateau dissecting smaller ones like

a. Maharashtra plateau: Much of this is underlain by the basaltic rocks where the rivers like Krishna, Godavari and their tributaries flow. It has got typical trappean topography where the hills and ridges have steep slopes and flat tops (mesa). The entire area is covered by black cotton soil, the regur.

b. The Karnataka or Mysore plateau: It is made up of archean rocks with

average height of 600-900m. It is a highly dissected plateau containing the heads of Cauvery and Tungabhadra rivers. Mulangiri in the bababudar hills are the highest. The plateau is divided into malnad, the hilly country with deep valleys and dense forests and the maidans are the plains sometimes having low granite hills. This plateau tappers and merges with the nilgiri hills.

c. Telangana plateau: It is made up of Archean gneisses with a height of 500-600m and drained by rivers like Krishna, Godavari, and pennar. This is divided into the Ghats and peneplains.

d. Chattisgarh plains: It is a saucer shaped depression drained by upper basin of Mahanadi. The whole basin lies between maikala ranges and the Orissa hills surrounding in all directions. It consists of horizontal beds of limestone and shale of kadapa age.

Aravalli ranges

They extend for 800km. between palanpur (Gujarat) to Delhi in southwestern to north eastern direction. They represent the relics of the Fold Mountains of Archean era with an average elevation of 400-600m. Gurushikar is the highest peak (1722m.) just below the mount abu. The gheran ghat pass separates the gurushikar from mt. abu. The other passes present are barr, piplighat, devaiar, desuri etc.,

Vindhyan ranges:

They rise as an escarpment flanking the northern edge of the Narmada trough. It runs east-west for over 1200km with an average height of 300-650m. Most part of it is composed of horizontally bedded sedimentary rocks. Western part is covered with lava and towards east it is limestone and sandstones. The vindhyas extend as barner and kaimur ranges. They are acting as watershed between the Ganga river systems and the southern river system.

Satpuras:

These are the 7 mountains running south of vindhyas between Narmada and tapti. Starts with rajpipla (Gujarat) to the maikalas through the mahadev hills for about 900km. They are regarded as the hoarst or the structural uplifts. The average elevation is 900-1000m. Dupgarh near panchmarhi on the mahadev hills is the highest peak with 1350m. Astamba (1325m.) is the highest peak in satpura hills.

Western Ghats:

Also called as sahyadris. They run from the tapati valley i.e., from the khandesh plains to a little north of kanyakumari for 1600km parallel to the Arabian sea with average height of 1000mts.

The entire Western Ghats show terraced and flat topped topography (mesa) and it is divided into northern, middle and southern sections.

Northern section:

It extends b/w 21° -16° north i.e., south of tapti to north of goa. Kalasubai near igathpuri (1646mt) is the highest and salher is the 2nd highest peak in Nasik (1567mt) bhorghat connection Mumbai and pune (khajath and khandala) and the thalghat connecting Mumbai and Nasik (kasara and igathpuri) are the imp passes. Varanda ghat and Khumbarli ghat connects pune and rathangiri.

Middle section:

This section extends between goa to nilgiris. They represent a rougher topography because of dense forests and high rainfall. Sansogor (1166mt) is the highest peak in goa. Mullayanagiri (1930mt) in Karnataka. The niligiri join sahyadris at gudalur, marking the junction of eastern & Western Ghats where dodabetta (2637m) is the 2nd highest (2554m). Southwest of nilgiris is present the kunda ranges which are more hilly with deep valleys.

Southern section:

The phalghat or palakkad separates the main sahyadris from the southern ranges. This is a gap of 24-30 km. wide connecting Kochi & coimbattore. South of the phalghat occur several flat topped hills of crystalline rocks which radiate in different directions from anaimudi (2695m), the highest peak of Western Ghats. The ranges towards north are called anaimalai having an average elevations of 1800 to 2000m towards north east are the palani hills with the average elevations of 900-1200m. To the south are present the cardamom or elaimalai. Western Ghats is one of the world's ten hottest biodiversity hotspots covering an area of 1, 60,000 sq.km. Consisting of 5,000 species of flowering plants, 139 mammalian species, 508 bird species, and 179 species of amphibians.

Eastern Ghats:

They are a chain of highly broken and detached hills from Mahanadi in odisha

to vaigai in T.N. They almost disappear between the Krishna & Godavari. Their mountainous characteristics are present only between Mahanadi & Godavari. Mahendragiri (1501m) is the highest peak in odisha but in madugurakonda ranges of vijayanagaram (A.P),Armakonda (1660), Galikonda(1643), Sinkrangutta(1620m) are the highest peaks. Between Krishna & Godavari a saddle is formed of gondwana formations. This is because the entire Eastern Ghats are eroded by the two rivers. They re-appear as continuous hills in kadapa, Kurnool as the archeate nallamalai hills with a height of 600-850m. They are composed of quartz and slate. Veligonda is at the southern end and palakonda is the highest range. Further south they are called javadi & shevroy hills with steep slopes. They are made up of charmockites (brown ranges). Karandamala & sirumala are the isolated hills between Cauvery & vaigai rivers. The tirumala & shevroys will be meeting the Western Ghats at biligiri ranga ranges.

Significance of peninsular plateau:

It is the oldest and most stable land mass of the world (craton).

It contains a rich variety of minerals (huge deposits of iron, manganese, copper, bauxite, chromium, mica & gold)

98% of the gondwana coal deposits are found in the peninsula. There are large reserves of slate, marbles, granites & sand stones.

The north-western plateau is covered by fertile black soils.

Different types of forests are present from tropical rain forests to the deciduous forests and scrubby forests.

It is having a good hydro electric potential.

The deltas of the south are known as “granaries of southern India”.

The tourist destinations like hill resorts, archeologically important centers and historically relevant centers are present.

4. The coastal plains:

They run for 6,000km from runn of kutchch in west to ganga-brahmaputra delta in the east. They are divided into the west coastal plains and the east coastal plains.

West coastal plains:

These are the sub-merged plains and are confined to a narrow zone of width ranging from 10-25 km. They are quite narrow in the middle and broader in north and south. This is a fault coast with several projections into the sea farming open bays. It is an indented coast with large number of coves and creeks. It has been divided into the following.

a. The kutchch peninsula:

The important physiographic feature is the sandy plain and the coasts are fringed with sandy dunes. It is raising only a few meters above the sea level. Towards north it is called the great rann and towards east it is called little rann. Most of the area is formed of sun baked dark silt at few places the grasses break the monotony of the otherwise flat plain.

b. Kathiawar peninsula:

It lies to the south of kutchch, on east & north east it is encircled by the little ran. Average elevation is less than 200 m. and the central part is having the mandav hills where mount ghirnar is the highest peak (1117m) and the gir ranges are located in the southern part.

c. Gujarat plain:

This plain lies to the east of kutchch & Kathiawar peninsula and slopes towards west & south-west. This plain may be described as an intrusion of indo-gangetic conditions into the peninsula and are formed by the alluviums of rivers like Narmada, tapti, Sabarmati & mahi which all drain into the gulf of khambat. These are low lined plains with average height of less than 150 m. The coast is covered by wind blown loess giving a semi arid look to this land scape. The saline marshes near the coast are prone to floods during high tide.

d. The konkan plain: South of Gujarat from Daman till goa for 500km is called the konkan plain. It has marine erosion features like cliffs, shoals, reef & islands.

Cliff: The straight cut slope of marine erosion.

Shoal: Flat surface below the water surface.

Reef: colonies of polyps.

Below Mumbai there are a series of bays & beaches present.

e. Karnataka plains:

This stretches from goa to mangalore for about 225km and the width is very narrow, especially in the central part between cape ramas and coondapur in Karnataka are crossed by numerous spurs projecting from the Ghats reducing the low lands to 5-7km. only.

f. Malabar or kerala plains:

They are running from mangalore to kanyakumari for a distance of 500km. and are wider than Karnataka plains. Lagoons or back waters or kayals (in kerala) are the important features of Malabar plains. Lake Vembanad is a lagoon which is 75km long and 5-10 km wide having a spit of 55km. long.

East coastal plains:

They are the emergent type plains running from river Subarnarekha i.e., from the edge of the Ganga delta to kanyakumari. Major parts of these plains are formed due to the alluvial fillings of Mahanadi, Krishna, Godavari & Cauvery. This plain is characterized by lagoons, fine sea beaches, sand ridges & off shore bars. The western boundary is discontinuous because of the detached Eastern Ghats.

These are extensive plains with average width of 120 km. and ranging between 35-200km. In between Mahanadi & Krishna Rivers they are called as northern circars and between Krishna & Cauvery they are called as carnatic plains. They are divided into 3 regions.

a. Utkal plains: These are the coastal plains of Orissa extending for 400km. from river Subarnarekha to a little south of river rushikulya including Mahanadi delta. Chilka Lake is most prominent which is to the south of Mahanadi delta. It is 70 km long and 22km. in north-east to 7 km. in southwest. Its origin is because of the formation of a bay mouth bar. It is the largest or biggest brackish water lake of the country covering an area of 1144sq.km.

b. Andhra plains: South of utkal to the Pulicat Lake some 40km. north of Chennai are called Andhra plains. The most significant feature is the delta formation by Krishna & Godavari. This combined delta is advanced by 35km. into the sea. This is evidenced by Lake Kolleru, once a lagoon and at present it lies far inland. Sriharikota Island is a long sand spit on lake pulicat. The

Andhra plains have a straight coast except harbors like Visakhapatnam & machilipatnam.

c. Tamilnadu plains: Also called as coromandel plains. It stretches from Lake Pulicat to kanyakumari for 675km. Average width of 100km. The important feature is the Cauvery delta which is the granary of south India.

Significance of coastal plains:

Large parts of the coastal plains are covered by fertile soils where rice is the major crop and the coconut trees grow all along the coast. The coasts are surrounded by sedimentary rocks containing large deposits of mineral oil.

The sands of A.P & Kerala have monazite sands in adequate quantities from where we can extract thorium (nuclear fuel). Fishing is an important occupation throughout the coast.

Gujarat coast is famous for producing salt.

The entire length is dotted by several ports (12 major & 200 medium & minor) from where more than 90% of international trade by volume takes place.

DRAINAGE SYSTEM

- India is blessed with 100s of small and large rivers which drains the length and breadth of the country.
- They are important natural resources because they are rich in mineral content and are used for agriculture, industries, production of hydro carbons, domestic purposes, inland transport, and marinery.
- Most of the fertile lands are formed because of depositions of rivers.
- Average rainfall of India-118cms/ 36.45 lakh million cubic mT of water.
  Min-10 cms- North West
  Max-1200cms-east
- Out of 36.45 lakh million cubic mT, 34.3% of water goes back to the atmosphere through evaporation
  20.6%-penetrates into the soil
  45% -rivers
- All the river basins are divided into 3 based on size.
  1. Major, 2. Minor, 3. Medium.

Major rivers:

14 are present in India.

Catchment area-20,000sq.km. 85% of water of India is from these rivers.

Indus, Ganga, Brahmaputra, Sabarmati, mahi, Narmada, Tapti, Mahanadi, barakka, brahmini,

Godavari, Krishna, Cauvery and penna-peninsular

Medium rivers:

2,000 to 20,000 sq.km. 7% of the total water in India. 44 medium rivers are there in India.

Minor rivers:

Catchment area - below 2,000 sq.km.

They are found in dry areas and coastal plains especially in the western coastal plains.

About 90% of the water from the rivers drain into the Bay of Bengal.

Westward flowing rivers cover 23% of the surface area.

Except Narmada Tapti all the rivers flow towards east.

Evolution of rivers:

- Himalayan rivers are called antecedent rivers since they are formed before the formation of Himalayas.
  The rivers that flow towards three ranges of Himalayas are Indus, Sutlej, gandak, gagra, kosi and Brahmaputra.
  Two ranges-chenab, ganga, sarada
  One range-gomti,
- It is believed that rivers were formed before the Himalayas because of the evolution of deep gorge.
- Peacog said that indo-brahm was the long river before Himalayan formation.
- Pilgum said that there existed river in shivaliks.
- Brahmaputra-33.8%
- Ganga-26.2%
- Godavari-6.4%
- Indus-4.6%
- Narmada-3.6%
- Krishna-3.4%

- Mahanadi-2.9%

Indus system:

- One of the largest river system in the world.
- Greeks called it sindhos, latin called it sindhus, Sanskrit-sindhu.
- Above 5,182 m height, it emerges at Manasarovar Lake. At 4,106 m, it enters India.
- Catchment area-11.78 lakh sq.km. In India-3.21 lakh sq.km
- Width – 2,800km.
- It passes between the Ladakh and jhasker ranges at skardu, Indus joins shyok in the north and gilgit, hunza, dras, astar, Kabul.
- At nangaparbat, it takes a south ward bend and Kabul river originates from hindukush region and rest are from karakoram and Ladakh ranges.

Jhelum:

The Jhelum originates in Pirpanjal near Banihal pass at Verinag which is 80 km from Srinagar and the Jhelum river flows through the Wular lake and passes through the valley of Kashmir,

It emerges on to the plains near Mirpur at the edge of Potwar plateau in Rawalpindi of Pakistan and it forms a boundary between India and Pakistan for 170 km and the total length of Jhelum is 724 km. The Jhelum is also called as Vitasta-Sanskrit, Vyeth-Kashmiri, Gurumukhi-Punjabi, Shanmukhi-urdu

Chenab:

It will be originating as 2 streams Chandra and Bhaga and joins near Tandi

Total length:1180 km and it emerges on to the plains at Raisi in Jammu.

Originates at Baralachala of Jaskar ranges and Chenab is called as Askini (or) Iskmathi (or) Acesines.

The Chenab and Jhelum meets at a place called TRIMMU

Ravi:

The Ravi originates at Kulu hills in Chamba District near to Rothang pass.It emerges on to the plains at Madhopur and it is the smallest of all the five

tributaries,it has got 2 tributaries joining from south.

Budhil river ; It originates at Mani Mahesh Kailash peak in Lahul valley.

Nai (or) Dhona ; It originates at Kalidebi pass at Triloknath Peak

Beas:

It originates from the VyasKund in the southern end of Pirpanjal near to Rohtang pass.Beas is called as Bipasa,Arjikiya,Vasista,Hyphasis.

The Chenab and Ravi rivers meet at Ahmedpur sial in the Punjab of Pakistan.

Sutlej:

It originates from Dharma pass in between ManasSarovar and Rakas lake. ManasSarovar is called as Langchchan khabab. Sutlej river is also called as Red river because it is flowing in Tibetian Red soils (or) Langquin in Tibet. It emerges on to the plains at Ropar in Punjab (India) .Sutlej is also called as Satadri (or) Sutudri.

Beas and Sutlej meet at Hari-ke-patan in Punjab (India) and this combined stream forms a boundary between India and Pakistan for 120 km from Firozpur to Fazilla.

The Chenab and Sutlej meet at Uch Shariff. The Panchnad (or) Panjnad is a combined stream of 5 Indian tributaries and joins Indus at Mithankot (or) Chacharan.

Indus river joins Arabiansea at a place called Kalibagh

Ganga:

The average depth of Ganga is 52 feet. Maximum depth is 100 feet.

Yamuna emerges on to the plains at Paonta in Himachal Pradesh. At Mathura (UttarPradesh) it will be turning itself in South-East direction, it runs parallel to Ganga (i.e, main river) so called Yaju.

Chambal river: originates to the South-West of Mhow in Janapao hills of Vindhyan ranges, flows through Malwa Plateau.

Gives bad land topography. It joins Yamuna in Etawa district of UttarPradesh.

Banas is the tributary of Chambal.

Sindh originates in the Vidisha Plateau of Malwa region. It has 2 tributaries “PHAHUJ” and “KWARI”.

Betwa- has one tributary Dhasan and joins Yamuna near Hamirpur.

Ken- rises near Barner – Kaimur ranges. Its tributary is Sonar and this joins Yamuna near Ghila – Fetehpur (U.P)

Son: rises from Amarkantak Plateau and joins Ganga at Danapur,Patna. It first flows in Northern direction and after the Kaimur ranges it flows in North-Eastern directions. The tributaries of Son are Johilla, Rihand, Gopat, Kanhar, North Koel.

Damodhar: rises in Chota-Nagpur Plateau (Sorrow Of Bengal).It joins Hugli river 48 km after Kolkata.

RamGanga: rises in Gharwals near Nainital, it enters into the plains at Kaladarh and joins Ganga at Kanauj.

Tributaries of RamGanga are Khoh, Gangan, Aril, Kosi, Deoha (Gorra).

Gomati: originates in Gharwal and joins Ganga after Benaras.

Ghagra: originates near Gurla-Mandhaka peak, South of ManasSarovar. It is called as River Kharnaili in Nepal. It joins Ganga at Chapra and gets divided into many branches of which Koriyab and Garwa are important.

Tributaries of Ghagra are Sarada, Sarju and Rapti. On the banks of Sarju (Sarayu) Ayodhya is located.

Kali river: originates at the boundary between Nepal and Kumaons. Kali is also called as Chauka river. It emerges on to the plains near Tanakpur.

Gandhak: originates near Nepal-Tibet border and it is called Narayani. It’s tributaries are Bhanumati, Indumathi, Baghmathi in Nepal. It enters in to plains at Tribeni and joins Ganga at Hajipur in Vaishali District of Bihar. It’s tributaries in India are Kali, Gandhak, Mayangodi, Bari, Trishuli.

Kosi: popularly known as SaptaKaushaki with 7 streams namely Sutkosi, Tamba, Talkha, Doodh, Botia, Arun, Tamber. These 7 streams mingle together to form 3 tributaries-TumarKosi, ArunKosi and SonKosi. These three meet at a place called Triveni, which is to the north of MahaBharat Ranges in

Nepal. All 7 streams near Sikkim, Nepal and Tibet borders. These streams are fed by the glaciers of GowriShankar, Everest, Makalu and KanchanJunga.

Kosi joins Ganga near Kurusela. Kosi has shifted its course Westwards by 112 km during the past 250 years. Kosi is called Sorrow of Bihar.A barriage was built in Nepal near Hanuman nagar in 1965 to control Kosi.

The Ganga river is a braided river with numerous sand bars and channels.

BRAHMAPUTRA

It originates from chemayungdung glacier. Recently Chinese have said that it originates from angsi glacier. This glacier is present to the south of konggyu tsho which is 100 km away from the manasarovar & just 35 km away from the birth place of Sutlej river.

The mariam la pass separates this glacier from the Manasarovar Lake. Its length in India is 880 km.(2900 km in total).

It is called as tsangpo in tibet.

The river bed is present at a height of 2535m at tradem (teladuama).

THE PENINSULAR DRAINAGE SYSTEM:

Evolution:

Geologists believed that the sahyadri-aravalli axis was the main water divide in the geological past. One hypothesis assumes that the existing peninsula is the remaining half of the bigger land mass called gondwana.

Almost all the major rivers of the peninsula are in their matured stage and have reached the base levels of their erosion and flow in broad, shallow & graded valleys. The river velocities are very low because of their low gradient due to which the carrying capacity decreases and delta formation sets in.

The western Ghats acts as the chief water divide but most of the peninsular rivers flow towards east except the narmada & tapti. Although the general direction of the river flows is from west to east but careful study reveals 3 main directions.

1. Mahanadi, Krishna, Godavari, Cauvery & several smaller rivers drain south-east into bay of Bengal.

2. Numerous streams of western Ghats along with Narmada & Tapti flow west into Arabian sea.

3. the tributaries of ganga & Yamuna flow in north-easterly direction.

East flowing rivers:

1. Mahanadi:

Literally means the big river. It originates in the northern foothills of dandakaranya near sihawas(dharsiya village) in chattisgarh. It originates at an elevation of 442m with a length of 857km. the total drainage is 1.42 lakh sq.km. Its upper coarse lies in a saucer shaped basin which is surrounded by hills in north-west & southern direction. It emerges from eastern Ghats at tikkarpara ranges and at narraj. It forms a slightly arcuate delta which is 11km from cuttack.

Left bank tributaries:

Ib, mand, hasdeo, sheonath.

Right bank tributaries:

Ong, jonk, tel

2. Godavari:

It is the largest river system of the peninsular India and next only to the Ganga basin. The riparian states include Maharashtra, A.P, M.P, chattisgarh, Orissa, Karnataka.

It is called as vridhganga having a total length of 1465km & drainage basin of 3.12 lakh sq.km. the source of it is in triambak plateau of northern sahyadris near nasik just 80 km away from the Arabian sea.

It forms a low base delta with a round bulge having many distributaries. It has a water front of about 120 km.

Left bank tributaries:

Penganga, warradha, wainganga, indravati, sabari, pranhita etc.,

Right bank tributaries:

Manjira

KRISHNA

It is the 2nd largest east flowing river. It rises from a spring near mahabaleshwar just 64 km from the Arabian sea. Its length is 1400km with 120 km of water front. It forms a digitate delta (bird foot delta).

Tributaries:

Most of its tributaries are right bank tributaries & the important ones are the koyna, bhima, ghataprabha, malaprabha, Tungabhadra, musi etc.,

Koyna is a small tributary but famous for its dam (koyna dam, which gave rise to lather earthquake).

Bhima- it originates in matheron at the bimashankara hills. The total length of it is 861 km. mula, mutha, ghat, nora etc., are its tributaries.

Tungabhadra- it originates from central sahyadris as two streams, tunga originates at varahaparvatha & bhadra originates from gangamula hills and they both meet at a place called koodali.

Its length is 511 km and its tributaries are hagari and vardha.

Musi- it originates at anantagiri hills of vikarabad and joins Krishna at vajirabad in nalgonda.

CAUVERY:

It is designated as ‘ ganga of the south’.

It originates at talakaveri on brahmagiri ranges at an elevation of 1341 m in the coorg plateau of Karnataka. It is the only perennial river in the south which receives bimodal rainfall, in the summer by south west monsoons and in the winter by north east monsoons.

It flows for a length of 800 km in its path. It descends from the Karnataka plateau into the TN plains, as the shivanasamudra waterfalls (101m).

At srirangam it bifurcates into two channels. Northern one is called kollidam and the southern one retains the name kaveri.

It forms a quadrilateral delta covering 8000 sq.km of area. The delta has several terraces indicating that it was subjected to repeated upliftments &

erosions.

Cauvery forms a waterfront of 130 km.

Northern tributaries:

Herangi, hemavathi, lokapavani, arkavati, srimsha etc.,

Southern tributaries:

Lakshmanateertha, kabana, suvarnavati, amaravathi, bhavani.

South of the Cauvery river there are several streams of which vaigai river is the largest. It flows through the dry channels brcause it has the tendency to get lost intermittently in it's coarse.

Vamshadhara & nagavali rivers in the eastern ghats debounces into bay of Bengal on the coarse of vijayanagaram(srikakulam).

Palar & ponnayar flow above Cauvery in T.N.

Tamraparni originates from agastyamalai hills below vaigai.

Some of the other east flowing rivers which flow in north-south directions are

Subarnarekha- originates in the ranchi plateau at an elevation of 600m and forms estuary between ganga & Mahanadi rivers after flowing for 395 km. In its lower coarse it forms a border between W.B and Orissa.

Bramhani- two streams koel & shank originate from ranchi plateau and join together near Rourkela to form brahmani. Its mouth becomes northern end of the Mahanadi delta. Its total length is 800km. It has some of the tributaries like sankhad & tikra etc.,

Penneru- it originates from nandidurga peak in Karnataka and flows northward entering into A.P and then takes eastern direction to form an estuary before plunging into bay of Bengal. The total length of it is 597km.

Tributaries: jayamangali, kunderu, sagileru, chitravathi, papaghni, cheyyeru etc.,

West flowing rivers:

They are smaller & fewer in number. The two major west flowing rivers are Narmada & Tapti. This exceptional behavior is explained by supposing that

they run in fault plains. According to some of the geomorphologists, it is due to the sagging or bending of the northern peninsula at the time of Himalayan upheaval. These rivers form only estuaries because they flow through the hard rocks and are unable to form the distributaries.

Narmada:

It rises from the amarkantak plateau in the annupur district of M.P (Shahdol according to kuller) at an elevation of 690m and flows through a rift between the vindhyas & the satpuras for 1310 km.(1078km in M.P alone).

In its coarse it forms a boundary between maharashtra & M.P for 32 km and between gujrat & Maharashtra for 40km.

At Jabalpur, it cascades 150m down into deep gorge forming dhuandhar waterfalls or cloud of mist waterfalls.

The gorge is composed of the marble rocks. Below Jabalpur, it flows on a narrow, elongated well defined basin and form two of the waterfalls called Mandhar and dardi of 12 m each.

Near Maheshwar it forms Shahasradhara waterfalls. Near Gardeshwar it emerges from the hills and meanders through the alluvial plains passing Barouch.

It enters a Gulf of Khambat with a wide mouth of 28km where Aliabet is the estuarine island present.

RBT's

Hiran, Orsang, Barna, Kolar etc.

LBT's

Burhner, Banjar, Shar, Shakkar, Tawa, Kundi etc.

TAPTI

It is called the twin or handmade of Narmada.

It originates from Multai tank on the Satpuras in Betul district of M.P. Flows for a distance of 730km.

It traverses in the plains and the plunges into a rocky gorge of Satpura hills. After crossing Nemar region of M.P, it enters the Khandesh plains lying

between Satpuras and Ajantas.

For about 48km stretch in its lower coarse it is tidal in nature and empties itself into the Gulf of Khambat.

RBT's

Betul, Patki, Ganjal, Dathranj, Bokad, Suki, Kanki, Guli, Gomai, Valer etc.

LBT's

Poorna, Ambora, Khursi, Khokri, Bori, Amaravati etc.

SABARMATI

It rises from the hills of Mewar in the Aravallis as river Sabar. After joining Hathmati, it is called Sabarmati.

It flows through a gorge Dharoi and falls into the Gulf of Khambat, after its length of 320km.

Tributaries:

Sedhi, Wakul, Harnav, Meshwa, Vatrak etc.

MAHI

It rises in the Vindhyas at an elevation of 500m and flows to a distance of 533km before plunging into the Arabian Sea at Gulf of Khambat.

Tributaries:

Som, Anas, Panam etc.

LUNI

It is called as Lonari or Lavanavari i.e., salt river.

It originates in the west of Ajma in the Aravallis at an elevation of 550m.

It flows in the south westerly direction and gets lost finally in the marshy grounds of Rann ok Kutchch.

Its upper coarse is called Sagarmati. After joining with the river Sarusuati, it is called Luni.

West flowing rivers of Sahyadris:

There are about 600 small streams falling into the Arabian Sea from the steap slopes of Westerten Ghats due to the excess rasins received by the western coast. Out of these only few are important ones.

In goa: mandovi, zuari, rachol.

In Karnataka: kalinadhi, gangavalli, bedti, sharavati, netravati, & dadri

In Kerala: beypore, pamam, periyar, pamba are some of the imp. rivers.

The rivers of the goa are called as the black rivers due to the transportation of iron ore & coal through these rivers.

INLAND DRAINAGE

The rivers which do not reach the sea constitue the inland driange.

Larger parts of Rajastan & the parts of Aksaichin in Ladakh has got inland drainage system.

Ghaggar-It is a seasonal stream forming a boundary between Haryana & Punjab during the rainy season.

After traversing for 465km, it gets lost in sand of Rajasthan near Hanumanagar.

In rainy season, its bed becomes 10km wide.

This river is considered to be the successor of the legendary saraswati river.

Its dry bed is still traceable under the Rajasthan desert.

CLIMATE OF INDIA

Latitudinally, India lies half in the tropics & half in the sub tropics or temperate. But basically because of the Himalayan ranges which insulate the Indian subcontinent from the rest of Asia, the cold waves of temperate latitudes are obstructed. Climatically India is treated as a tropical country with tropical climate but it is very much diversified in nature i.e., from tropical to

cold and arid to humid.

Inspite of all these, India is called as a typical monsoonal country. This is because the monsoons dominate the Indian climate.

Influencing factors:

There are several factors which are influencing the climate of India. They range from the ground surfaces to the atmospheric circulations and they include:

1. The tropical location of the country.

2. The relief features i.e., orographic features present on India.

3. The surrounding oceans from where the moisture is carried on to India.

4. The upper air circulations are in form of the jet streams & the Hadley cells.

5. The oceanic disturbances i.e., the water cycle, el nino, enso etc.,

The Indian meteorological department has broadly divided into 4 distinct seasons, with distinct seasonalities where the annual cycle of the seasons follow a precision with

1) Hot dry season
2) Hot wet season
3) Cold wet season
4) Cold dry season

First and second are called summers and third and fourth are called as winters by the international meteorologists.

1) HOT DRY SEASON:-

It is also called as pre monsoon season or summer. This season is from 15th March to 15th June where the ground is prepared for the monsoons. This is because the apparent movement of the sun in April is exactly over the Indian sub continent.

Most of the places record the temperature of more than 30 degrees with north west India averaging 45 degrees, peninsular India 40 degrees and the rest with 32 degrees.In this season dry hot winds blow with dust storms and are called differently in different parts of the country .

Loo – Punjab and Haryana
Anadhi – UP
Kalbaisakhi - WB
Cherry blossoms - Karnataka and Kerala
Mango winds - AP and Tamil Nadu

The rainfall do occur in this season which is conventional in nature and it is around 5 to 10 cms. In south India these rains are called as the mango showers. In Maharashtra they are called as Aamravarsha. There will be an intensification of low pressure area along the Indo-gangetic plains. In WB, there are some local storms which are associated with violent winds, torrential rains and hailstorms called norwesters.

2) HOT WET SEASON:-

It is also called as monsoonal season. It is between 15th June to 15th September. The south west monsoon enters into the country. Country experiences high heat, high humidity extensive clouding with several spells of moderate to heavy rainfall. The low pressure belt of the summer becomes the monsoonal trough. India receives its 3/4th of the total rainfall. The monsoons strike at Andaman on 20th may and on the Kerala coast on 1st June. The variability of rainfall is extreme though the average is 118cms. (Mawsynram average rainfall is 1221cms present at an elevation of 1329mts where as Jaisalmer is 12cms.

3) COLD WET SEASON:-

It is also called as retreating monsoon season or the post monsoon season or north eastern monsoon season. During the winters, low temperature is recorded on the land with high pressure around the indo gangetic plains and the adjacent oceans are with low pressure areas. During this season, a large number of cyclones occur both in Arabian sea and the Bay of Bengal. This season extends from 15th September to 15thDecember. The cyclones of Bay of Bengal give rainfall to the coasts of Tamil Nadu, AP and Orissa. The cyclones of Arabian Sea which originate below 16degrees north will dissipate into the Arabian Sea without giving Showers (by north east monsoons). The cyclones above 16 degrees north latitudes will be originated during the hot wet season and flood the coast of Gujarat and Konkan. The wind direction during this season is from north east and they are dry because of their continental origin (they are the planetary winds). These north eastern trades while passing through the Bay of Bengal accumulates moisture which will be deposited on to the coast of southern AP, TN and parts

of Kerala in the form of rainfall. More than 80% of rainfall for the coromandal coast is from the north eastern monsoons.

Even the north western India (Punjab, Haryana, and western UP) also receives 5-10cms of rainfall from the western disturbances of the Mediterranean Sea. This is ideal for the winter wheat crop.

4) COLD DRY SEASON:

This season is associated with the clear skies, pleasant weather, low temperature with low humidity and high range of temperature (diurnal temperatures). The suns journey is completely south-ward. The dras and Kargil sector of the Kashmir records the lowest of temperatures during this season. The average will be around -40^{o} C but on 28th December, 1908 it recorded -45^{o} C. The north India is cool, where as the temperature of south India will be above 20^{o}C with Thiruvananthapuram recording more than 31^{o} C.

MONSOONS

The term is derived from Arabic word 'Mousin' or Malayan word 'Monsin' which means season. The Monsoons are the seasonal winds which completely change their direction of flow with the change in season. The flow will be from sea to land and vice versa in winter. A Precise definition is not been given for monsoons. Many scholars have tried to define it like A. A. Ramasastri, H.G.Dobbi, Conrod, Koppen, Angot, etc., C.S. Ramage suggested 4 features of monsoon winds. Based on his suggestions the monsoonal region is an extended rectangle, extending between mid Atlantic to mid pacific.

MECHANISM OF THE MONSOON:-

Origin of the monsoons is still a mystery and several attempts have been made but no explanation is satisfactory till day. Broadly the theories regarding the monsoons are divided into two categories.

1) Classical theories
2) Modern theories

CLASSICAL THEORIES

Monsoons are mentioned in rig Veda and in several writings of Greeks and Buddhists scholars. But the credit for first scientific explanation of

the monsoons goes to the Arabs. Al-Masudi in 10th century gave a brief account of monsoons over the north Indian Ocean. The date of commencement of monsoons at several places was reported by sidiali in 1554AD.

MODERN THEORIES:-

1) Thermal concepts :

In 1686, Edmund halley explained the monsoons resulting from the thermal contrasts between the continent and the ocean due to differential heating. He conceived summer and winter monsoons depending upon the seasons.

a) Summer monsoon: In summer, the sun shines vertically over the tropic of cancer resulting in the high temperature and low pressure in central Asia. But the pressure is sufficiently high over the Arabian Sea and the Bay of Bengal. This indicates the movement of air from sea to land which bring heavy rainfall to India and neighborhood.
b) Winter monsoon: In winter, the sun shines vertically over the tropic of Capricorn the north western part of India grows colder than the Arabian Sea and the Bay of Bengal and the flow of monsoons is reversed. Halley's ideas are basically the land sea breezes on a seasonal basis and continental scale.

AIR MASS THEORY: This was given by Flohn. According to him the monsoons are the extensions of south east trades into the northern hemisphere. This is because in July the ITCZ lies at 20-25degrees north latitudes. ITCZ is a zone of ascending air and also the meeting point for south eastern and north eastern trades. Under the influence of Coriallis force and according to the ferrals law, the south eastern trades after entering into northern hemisphere gets deflected towards their right hand side and approach India in the form of south west monsoons.

UPPER AIR CIRCULATIONS THEORY: It includes the jet streams and Hadley cell.

Jet streams:

These are the swiftly moving geostrophic air streams in the upper troposphere that meander in a narrow belt with speeds ranging between 150-240 km/hr. any wind which moves parallel to the isobars is called

pressure. The jet streams steer the monsoons. In winter they blow below the Himalayas. In summer they blow above Tibetan edge. This was explained by Pierre Pedalabode. Mr. M. T. Yin explained that the burst of monsoons depends on the upper air circulations i.e., the jet stream. Mr. Yin and Pedalabode said that a warm core anti-cyclone is developed in the upper troposphere of the Tibetan plateau. This anti-cyclone was identified by the radio sounding methods. P. Koteswaran in 1952 tried to establish a relationship between the monsoons and the atmospheric conditions prevailing over the Tibetan plateau. The Tibetan plateau which is at a height of 4 km, covering an area of 4.5 million sq. km, acts as a heat engine due to a rise of temperature of about 1 or 2 degrees. This attracts the winds of the Indian Ocean towards it because of the low pressure created and due to the presence of the anti-cyclonic conditions over the Tibetan plateau. The winds ascend and are thrown outward. In this process the easterlite jet stream develops, some of which go into the Indian Ocean and some come along the axis of Kolkata and bengaluru, towads the eastern African coast, which are again intensified by the south eastern trades. The strength of the easterly jet stream is directly related to the intensification of the permanent high pressure over the south Indian Ocean.

OCEAN CURRENTS THEORIES:

1. El-Nino:

A Spanish word which means “child Christ” or “baby boy”. El-Nino is an unusual, unseasonal weather phenomenon associated with the southern pacific along the Peruvian coast. It is a climatic accident because generally cold currents i.e., the Humboldt or the Peruvian currents flow on the pacific coast of South America, but with a gap of 8-12 years. This coast gets the warm current flow due to the southward shift of the south equatorial currents causing heavy rainfall and flooding takes place in peru and chile coast. It is a common observation during the El-Nino that india doesn’t get good rainfall. But, it has been observed that during the past 100 years, out of 43 rain deficient years only 19 were associated with the El-Nino. In 6 El-Nino incidental years, we got good monsoons.

2. Southern oscillations:

This was explained by Sir Gillbard Walker in 1920 through his Walker cycle and southern oscillations. Due to the changes in the sea surface temperature, there occur changes in the pressures of the equatorial Indian and the pacific oceans. This sea surface temperature also influences the ITCZ. Walker gave

the indices based on which we can calculate the efficiency of the monsoons.

Positive southern oscillations: Whenever there is high pressure on eastern pacific and low pressure over the Indian Ocean i.e. the Tahiti islands of French Polynesia have high pressure than that at Port Darwin, we will get good monsoons.

Negative southern oscillations: Whenever the high pressure is observed over the Indian Ocean than the eastern pacific, the waters from the Indian Ocean are attracted towards the eastern pacific and India doesn't get good monsoons.

Enso: The El-Nino and southern oscillations together form Enso. This is because whenever there is El-Nino in the southern pacific, they have observed the southern oscillations of the Walker cycle. The recent studies indicated that there are several other global parameters responsible for the monsoons.

POWER REGRESSION MODEL: After the 1987 drought, the power regression models were developed by taking 16 multi-dimensional parameters to forecast the monsoons by utilizing signals around the world. The 16 parameters were broadly divided in 4 as,

a) Temperature related (6):
   El-Nino in the current year
   El-Nino in the previous year
   Temperature in North India during March
   Temperature in the east coast of India during March
   Temperature in Central India during May
   Temperature in the northern hemisphere during January and February

b) Pressure related (5):
   Pressure anomaly in Tahiti and Darwin during spring
   Pressure difference at Darwin during spring
   Pressure over South America, specifically over Argentina in april
   Pressure over equatorial Indian Ocean during Jan & May
   Surface pressure anomaly of North Eastern hemisphere

c) Wind related (3):
   500 hecta pascal ridge in april
   50 hecta pascal ridge trough extend in Jan & Feb

10 hecta pascal westerly wind in Jan

d) Snow related (2):
Snow cover of the Himalayas in Jan & March
Snow cover over Eurasian continent during previous Dec.

Although this model is accurately forecasting the rainfall in India since 1989, it may not be the fool-proof model. The study of data coming from MONEX (monsoonal experiments), TOGA (tropical ocean global atmosphere), COARE (coupled ocean atmosphere response experiments), etc., is continuing and our meteorologists are hoping to discover some more parameters for forecasting the rainfall in India.

PROGRESS IN MONSOONS:- It is in the form of 2 branches.

1) Arabian Branch: It is more powerful than the Bay of Bengal branch for 2 reasons.
   a) The Arabian Sea is larger than the Bay of Bengal.
   b) The entire Arabian branch advances towards India whereas, only a part of Bay of Bengal branch enters India and the rest gives rainfall in the south East Asian nations.

The Arabian branch is divided into 3 distinct streams on arriving at the mainland of India.

1st stream:-

A part of it strikes the Western Ghats and gives rainfall to the west coastal plains. The average rainfall is 300 to 400 cms.

The rest of it gives rainfall to the major parts of peninsular India and the northern plains.

2nd stream:-

It enters the Narmada Tapti trough and reaches the central India, giving rainfall to MP, Maharashtra. Nagpur receives about 60 cms of rf due to 2nd stream.

3rd stream:-

This stream moves in the North East direction parallel to the aravallis. Only the southern edge of it obstruct the 3rd stream. The Mt.Abu gets a rainfall of around 170cms while the surrounding plains receive only 60 to

80cms of rainfall.

2) Bay of Bengal branch:

This divides into 2 streams when arrived at the mountain. It crosses the Ganga Brahmaputra and reaches the shilling plateau. It is here that the orographic effect is seen and the cherapunji to the west of maysyram receives record rainfall.

These 2 places are located in the southern slopes of Kasi hills at the northern end of the deep valley running from south to north which is in the form of a funnel.

The 2nd stream goes to the Himalayan foot hills after striking the mountains in Sikkim, it gets deflected to the west due to the Himalayan orientation and gives widespread rainfall to the south slope of Himalayas and the Indo Gangetic plains.

The rainfall in north India decreases from north to south, i.e. from foothills of Himalayas to ganga river and from east to west. For ex: Kolkata receives 119cms, Allahabad receives 91cms, Delhi-51cms and Bikaner 24cms.

The east coastal plains, the belt particularly southern AP & TN remains relatively dry because it lies to the rain shadow region of the Arabian branch and parallel to the bay of Bengal branch.

The monsoonal trough which forms across the ganga plains is due to the prevailing high temperatures on the NW India.

In the northern part of India, the pressure will be around 1000 milli bars and steadily increases towards south and reaches to 1008 to 1010 milli bars. Under this influence of pressure gradient, the winds blow in from the adjacent seas.

Break in the monsoons:

During july and august, the monsoons became weak and the rf ceases except in Himalayas. This is sometimes for a weak or 2-3 weeks long. These break is believed to be brought about by the collapse of the Tibetan high. This causes the shifting of the trough and the axis occupied at the Himalayan foothills. During this break, the heavy rf occurs over the sub-himalayas and the southern Himalayan slopes leading to high floods. In the indo-gangetic plains and a drought like situation in the peninsular India.

Monsoonal depressions:

A major part of the monsoonal rf is generated by the depression or the cyclones originating in the Arabian sea or the bay of Bengal. Almost all of them are sucked inwards towards the deltas of Cauvery, Krishna, Godavari, Mahanadi and ganga on the eastern coast and the depression of the Arabian sea travels to north and north-west affecting Gujarat and Maharashtra because they are super imposed by the SW monsoons.

Rainfall distribution:

It is very uneven and non-uniform over Indian landmass. The annual average rf of India is 118 cms but with large regional variations. For example, large parts of the Meghalaya and the north east receive more than 1000cms of rf where as Rajasthan receives around 15cms and in the extreme south, Kanyakumari and Nellaikattabomman districts gets less than 30cms of rainfall. So, based on the rainfall received, the entire India is divided into 4 areas or regions.

1) Areas of very high rainfall: - These are those areas receiving more than 200cms of rainfall and includes western coast from Mumbai to thiruvananthapuram almost whole of north east and north eastern tip of west Bengal.
2) Areas of high rainfall: - These are the ones receiving rainfall of 100 to 200cms and include the eastern slopes of west Ghats and major ports of northern plains, Orissa, Chhattisgarh, MP, AP and Tamil Nadu. The Isohyets of 100cms runs from Gujarat coast to Kanyakumari parallel to the Western Ghats. In the north the same isohyet trends eastwards from Jammu and Kashmir, Himachal Pradesh to northern UP towards Allahabad and bends westward at Bhuldelkhand by running over western MP, Eastern Maharashtra and northern AP.
3) Areas of low rainfall: - The ones which are receiving a rainfall of 50-100cms are put under this region. It includes large parts of Gujarat, Maharastra, Andhra Pradesh, MP, Karnataka, Eastern Rajastan, Punjab, Haryana and parts of U.P.
4) Areas of very low rainfall:- These are the desertic and semi-desertic areas receiving less than 15cms of rainfall and includes large parts of western Rajastan, Kutch and in the North Eastern Jammu and Kashmir(Ley, Ladakh region).

Peculiarities and significance of Indian rainfall:

- The climate of india is primarly dominated by south-west monsoons.
- The rainfall is variable and quite undependable.
- The monsoons arrive much before the due date and are considerably delayed.some times it is more than the normal and some times it is deficient.
- Some parts of country will be facing the fury of the floods while other parts are under drought.
- The seasons are cyclical and with precision.
- The Indian budget is gamble of monsoons .

Another peculiar feature is that the rainfall get concentrated in a few months that too not uniformly distributed over the country.the rainfall is basically torrential in nature.it pores but never rains and the rainfall is largely controlled by orography.

Climatic regions:

- India's climate is designated as tropical monsoonal climate as a whole, but with large regional variatitons accounted. Though the climatic variables include both temperature and rainfall the variations of rainfall are much more marked than those of temperature.hence most geographers have given more imporatant to rainfall than to temperatures.
- Blanford was the first to attempt to divide india into different climatic regions and several others also attempted subsequently of whom w.g.kendrew, l.d.stamp, koppen, thronthwaite, trewartha, and jhonson are worth mentioning.
- Among the Indian geographers subbrahmanyam (1955),barucha and shanvhag(1957)and r.l.singh (1971) are worth mentioning.

Threvarthas climatic regions:

- Professor glennj.threvartha of the university of Wisconsin in u.s.a has modified and simplified the koppens classification in his book called "an introduction to world climate" where he recognized six major climates in the world and are represented by capital letters they are
- A-tropical rainy climates .
- B-dry climate.
- C-humid mesothermal climate.
- D-humid micro thermal climate.

- E-polar climate.
- H-un differentiated highlandclimates .

Out of these 6 world climates only four types A, B, C and H are present in india. They are further sub divided 7 sub types.

A-tropical humid climate : in which the temperature does not fall below 18^{o} C in all the moths. It is having two sub types

1. A-(m): the tropical monsoonal type of climate.

    - The average temperature of 27^{o} C and the rainfall is over 250cm. it is present on the west coastal plains and Tripura.

2. A(w): the tropical wet and dry type of climate: it is also called the savanna type. The average annual temperature is of 27^{o} C but the rainfall is around 100cm. and falls during summer season. This type of climate is present in major parts of peninsular plateau and Mizoram.

B-type:

- It is a dry climate where the annual average rainfall is <100 cm and is divided into three sub types

1. B(s): semi arid (or) steppe type of climate where the annual average temperature >27^{o} C and the rainfall is <100 cm during the summer. This type supports only the grass lands and is present on the rain shadow region of the western ghats.
2. B(sh): it is tropical and sub tropoical desert type of climate where the annual average temperature are more than 27^{o} C and rainfall ranging between50-100 cm. This climate is present in large parts of gujarath,rajasthan and south west Haryana.
3. B-(wh): mid latitude desert type climate where the annual average temperature are sufficiently high and the rainfall is around 20cm, and is present on western rajasthan and kutch region of gujarath.

This climate supports only thorny bushes.

C- type:

It is a meso thermal / sub tropical climate where the winters are cold and dry.

It is having its single sub type c(aw) in india. In this sub type the winter temperature fall below 18^{o} C and most of the rainfall is in summer but it also gets the winter rainfall because of the western disturbances. This type of

climate is present in most parts of northern plains.

H- type :

This indicates the undifferentiated high land climate where the temperatures are invariably low.

The precipitation in winter is in the form of snow fall and in summer it is as the rainfall. This type of climate is seen in the Himalayan regions of jammu and Kashmir and h.p and in the hilly regions of uttarakhand, Sikkim and arunachal Pradesh.

Koppen's climatic divisions/regions:

Dr. Vladimir Koppen of the University of Graz in Austria given the climatic classification based on the decandoles vegetative classification of the world. He 1st published his scheme of classification of the world climates in 1901. Subsequently he modified it a number of times. The major modifications were in 1918, 1931 and 1936. In his last modification, a new scheme of climatic classification was given which is based on the annual and monthly mean temperature and precipitation. He considers the native vegetation as the best expression of the totality of the climate. So his climatic boundaries are based on the vegetative boundaries of the world. He says that the effectiveness of precipitation depends on the availability of moisture to the vegetation because much of it will be lost in the form of evaporation and transpiration by the soil and plants respectively i.e., most of it is lost in the evaporation and not available for the vegetation growth.

He says that even if little amount of rainfall falling in the cool humid climate will be useful for the vegetation but the same amount may not be sufficient in the hot and dry climates. Koppen suggested 5 major types of climates coinciding with 5 major vegetative groups of the world and are represented by the capitals letters A,B,C,D,E.

A type:

The tropical rainy climate with no cool season and temperature in coolest month is greater than 18^{o} C.

B type:

The dry climate where the evaporation exceeds the precipitation. It has got 2 sub-divisions.

1. S- semi arid or steppe type

2. W- arid or desert type

C type:

It is in the mid latitude rainy climate with mild winters where the average temperatures of the coolest months is below -3^{o} C and that of the warmest month is above 10^{o} C.

D type:

It is the middle latitude rainy climate with severe winters where the average temperature of the coldest months is below -3^{o} C and that of the warmest month is greater than 10^{o} C.

E type:

It is the polar climate with no warm season. The average temeperatures of the warmest month is below 10^{o} C. it has got two sub-divisions:

1. T-Tundra type-where the snow cover will be during the winter.

2. F-Icecap climate where there will be a perma frost condition.

These major climatic regions are sub-divided on the seasonal distribution of rainfall or degree of dryness or coldness and they are represented by the small letters like

a- The climates with hot summer with the average temperature of the wamest month is greater than 22^{o} C.

c- This is the climate with cool summer where the average temperature of the warmest month is less than 22^{o} C.

f- This is the climate with no dry season. Every month of the year will be getting atleast 2-5 cm of rainfall.

w- This is the climate with dry season in winter (summer rainfalls)

s- This is the climate with dry season in summer (experiences winter rainfalls).

g- The ganga type of climate where the summers are hottest with rainfall and

the hottest month is before solistice.

h- Heiss type of climate, where the annual average temperatures are more than 18^{o} C.

m- Monsoonal type with short dry seasons.

Based on these above criterias, koppen has divided India into 9 climatic regions.

A type- As, Aw

B type- Bshw, BWhw

C type- Cwg

D type- Dfc

E type- ET, EF

Amw:

Monsoon type with short dry winter season. This climate is found on the western coast south of Mumbai where the average rainfall is more than 300cm.

As:

The monsoon type of climate with dry summers. The rainfall in winter ranges between 75-100cm. It is from north eastern monsoons and found on the coramandel coast i.e., tamilnadu coast and part of southern AP.

Aw:

It is tropical savanna type of climate whose northern boundary coincides with tropic of cancer. The average rainfall is around 75 cms during the summer. This climate is found in large parts of peninsular India except the coramandel and Malabar coastal strips.

Bshw:

This is the semiarid steppe type of climate where the rainfall is varying between 12 to 25 cms during summer whih can support arid steppe vegetation. This is found in large parts of Rajasthan, Gujarat and Haryana

and also in some rain shadow areas of the western Ghats.

BWhw:

This is the hot desert type climate where the average rainfall is less than 12 cm and the temperature is very high. Hence the natural vegetation is completely absent. This is found in the western Rajasthan.

Cwg:

This is the monsoon type of climate with dry winters (mid latitude rainy climates where the winters are dry and Ganga type). The rainfall is in summer and the summer temperatures recorded are around 40° C and in winter the temperature falls to 27° C. this type of climate is found in the Ganga plains, the eastern Rajasthan, the malwa plateau and Assam.

Dfc:

This is the cold humid winter type of climate with short summer but humid. The temperatures in the winters are around 10° C and the winters are of longer duration. It is found in the north east except in Assam and Tripura.

ET:

The average temperatures vary from 0-10° C. There is a fall in temperature with the altitude (the snow fall is seen only during winter). It is found in the mountains of uttarakhand.

EF:

The temperature of the warmest month is ranging between 0-10° C and in the coolest month, it will be the subzeros. This type is associated with perma frost conditions i.e., the areas are covered with snow throughout the year found in the higher ranges of J&K, Sikkim & HP.

R.L.Singh's classification:

R.L.Singh divided India into 10 climatis divisions in 1971. This was based on the temperature conditions of the hottest and the coldest months and the average annual rainfalls, following the classification given by Kendrew & Stamp. The 10 divisions are:

1. Perhumid north east: This is the climate present in north east India where the july temperatures are ranging between 25 – 33° C. This is

the hottest month in north east. In January, the temperatures are ranging between 11-24° C. which is the coldest month. The annual average rainfall is 200 cms but there are also the areas whose rainfall is exceeding 1000cms.

2. Humid sahyadris and west coast: This is the climatic division of the western coast extending from Narmada valley to kanyakumari. The july temperatures are ranging between 26-32° C and the January temperatures are between 19-28° C. These are the hottest and coldest months respectively though the annual average rainfall is around 200 cms, it is higher on the western slopes of the western Ghats.
3. Humid south east climatic division: This is the climate present in Orissa, WB and parts of Chhattisgarh and northern AP. July is the hottest month where the temperatures are ranging between 26 to 34° C. and the January temperatures are between 12-27° C. Rainfall is ranging between 100-200 cms.
4. Sub-humid transition: This is the climate present in eastern parts of UP and the northern parts of bihar. The hottest month is july and the temperatures are souring very high ranging between 24-41° C and the coolest month i.e., the January, the temperature is between 9-24° C. The rf in these parts of the country is ranging between 100 to 200 cms.
5. Sub-humid littorals: This is the division consisting of south eastern coast of AP and eastern TN. May is the hottest month and the temperatures are varying between 28-38° C and the January temperatures are 20-29° C. Winters are cool. The rf is ranging between 75 to 100 cms and this is due to the retreating monsoons in November and December where as the summers are dry.
6. Sub-humid continental: This is the climate of the ganga plains, 26-41° C is the temperature recorded in the hottest month july where as in January, the temperatures are recorded between 7-23° C. The average rf is ranging between 75 to 100 cms.
7. Semi-srid and subtropical: This is the climate present in the Sutlej-yamuna water divide including the plains of Punjab, Haryana, eastern Rajasthan, Delhi, Chandigarh and parts of western UP. The hottest month is may and the temperatures are ranging between 26-41° C. The January temperatures are around 6-23° C which is the coldest month. The rf is ranging between 75 to 100 cms (some rf is by western disturbances).
8. Semi arid tropical: This climate is present in large parts of Gujarat,

Maharashtra, MP, AP and Karnataka. The hottest month is july where the temperature is ranging between 26-42^{o} C. and the January temperatures are between 13 – 29^{o} C. The rf is ranging between 250-100cm

9. Arid extremely dry climate:this is the climate present in Thar Desert ie.,the western Rajasthan along with the south western Haryana and Kachchh. In this climate both the diurnal and the annual range of temperatures are high. June is the hottest month with 20-41^{o} C temperatures. And the January temperatures are recorded between 5-22^{o} C . The annual average rainfall is around 25cm but there are some places where it is less than 12 or only 10 cm.
10. West Himalayan climate: as the name indicates ,it is the climate of western Himalayas including the states of J&K , HP &Uttarakhand where july is the hottest month& the temperatures are varying between 5-30^{o} C . and the January temperatures dips to 0 to -4^{o} C. The average rainfall is around 150cm in the summer it is due to the south -western monsoons and in the winter due to the western disturbances.

SOILS

DEFINITION:-

It is the thin natural surface dynamic layer of the earth comprising the mineral particles supporting or capable of supporting the vegetation and consisting of many complex, physical and biological activities going on simultaneously within it.

Soil is very important natural resource and the agricultural production basically depends on the facility of the soil.

The soil column extending down from the surface to the lower reach that is the Bed rock is called Pedon.

The soil scientists often visualize a pedon as an hexagonal column.

The display of the horizons on one face of the pedon is called as the soil profile.

Pedogenesis is the soil formation process where the Regolith [parent soil material] is subjected to physical, chemical and biological processes and

converted into the soil.

SOIL COMPOSITION:-

Soil contains all the three kinds of matter that is the solids, the liquids and the gases but the solids dominate which are both organic or inorganic in nature.

PROPERTIES:-

This includes the colour, texture, soil consistency and structure.

All these together determines the soil suitability for productivity.

1]Colour:-

It is the most obvious property of the soil and is determined by three measurable variables.

A) The Hue:

This is the dominant colour.

B) The Value:

This is the degree of lightness or darkness.

C) The Chroma:

This is the purity or the strength of the colour.

For example, The black colour usually indicates the presence of abundant organic matter that is the Humus.

Black colour also indicates the presence of Titaniferrous Magnetite in the volcanic rocks.

The red colour usually indicates the presence of Sesqui Oxides or the Iron Oxides.

The soil colour may in some areas be inherited from the parent rock but more generally it is the property generated by the soil forming process.

In some of the areas, it is the Transported property.

2] Texture:-

It is based on the varying proportions of Sand, Silt and Clay.

The texture is important because, it largely determines the water retention and the transmission properties of the soil.

Texture is an inherited features of a given soil and depends on the composition of the parent rock.

If the soil is sandy, water drains too rapidly, no water retention.

If clayey, water drains too slowly, holds most water.

If loamy, water holds intermediate amounts of water.

Size of the particles:

Gravels: more than 1mm.

Sand: 1mm-0.5mm.

Silt: 0.5mm-0.002mm.

Clay: less than 0.002mm.

1μ = 0.001mm.

3] Soil consistency:-

This refers to the quality of the soil that is the stickiness of the wet soil or the plasticity of the moist soil or the degree of coherence or hardness of the soil when it holds small amounts if moisture or in a dry state.

4] Soil structure:-

It is described in the terms of shape and size of the individual soil aggregates and four primary types of soil structures are recognized.

1) Platy:

The individual soil particles are arranged in the form of horizontal plates.

2) Prismatic:

It consists of vertical columns of soil aggregates often flat sided sticking on

side by side.

3) Blocky:

This consists of angular, equi-dimensional soil aggregates with flattened surfaces that fit and adjust into the other aggregates anf form the soil surfaces.

4) Spheroidal:

Here, the soil aggregates are more or less rounded with more spore spaces or granular when the soil is very porous.

The soil structure is important for water penetration and susceptibility of the soil erosion and for the ease of cultivation.

SOIL HORIZONS:-

These are the distinct horizontal layers set apart from one zone of the soil with another by differences in some properties. [Physical, chemical, organic and structural]

The horizons will be developed with the interactions through time, climate, the organisms present and the configuration of the land surfaces.

The upper most layer is called as the `O' layer or the Organic layer, because it consists of the dead organisms and leaf fall etc. which are under decomposed.

The next layer is called as the `A1' layer where the partial decomposition of the organic material has taken place.

`A2' layer is present below A1 which consists of fully developed soils with much biological activity.

Then comes the `E' layer which is also called as the Zone of Elluviation or Leaching Zone.

This is the zone from which all the smaller minerals seek into the lower layers along with the seeping water.

This zone is lighter in colour due to the lack of minerals.

Below the `E' layer, `B' layer is present which is known as the Zone of

Illuviation or the Zone of Accumulation.

All the minerals, which leached down from the `E' layer gets concentrated in this layer.

This is a mineral rich layer and is darker in colour.

A, E, B the three layers together are called as Solum or the Soil proper.

Below the mineral rich layer is the layer of Regolith called as the Sea layer.

The layer may be present or may not be.

This is the layer consisting of weathered parent material.

The lower most layer is called as the `R' or `D' layer which consists of the Bed rock that is the Consolidated rock beneath the soil.

FACTORS INFLUENCING SOIL FORMATION:-

The fall under two categories-

1] Active factors:-

Includes chemical and biological.

A) Chemical factors:

These are the factors influenced by solutional activities and this depends on the temperature when it acts along with the rainfall.

The temperature and rainfall are the most important variables of the climate.

Climate is the single most important factor associated with Pedogenesis.

The amount and seasonal distribution of temperature and the rainfall affects the soil formation.

When the climate acts for longer time, it reduces the differences among the parent materials because the climate controla the type and effectiveness of weathering of the parent rock romaterial.

For example, Two different parent materials may develop into the same soil in the same climate like the sand stone and granite will be giving the sandy soils in hot summer with no rainfall or any of the rock will be giving rise to the black

soil in hot summers and low rainfall.

Similarly, same parent material produce two different types of soils in two different climates.

For example- Crystalline granites will be producing laterite soils in the moist climates and non-laterites in the dryer climates.

In the areas of high rainfall, there will be high leaching, so the zone of elluviation becomes lighter and the zone of accumulation becomes darker in colour.

Because of the leaching, many of the important plant nutrients will be going into lower layers and the upper layers will be consisting of Alluminium and Iron related minerals.

Hence these soils are called as Pedalfar soils.

In the areas of high temperature and low rainfall, the leaching is lessened but evaporation is exceeding.

Hence the water from the underground sources or the deeper layers of soils comes onto the surface in the form of capillary action.

Once on the surface, the water evaporates leaving behind the salty layer on the surface.

These are called as the Pedocol soils.

B) Biological factors:

The presence of plants, animals and micro organisms cause biological activities in the soil layers and they are responsible for the addition of Humus [Decomposed organic matter].

Humification process increases the soil fertility.

Hence the dense forests has some best soils and there is a close relationship between the vegetation types and the soil present.

2] Passive factors:-

Includes parent rock, topography of the area.

A) Parent rock:

Most of the soils will be inheriting the characteristic features of their parent matter.

For example- The limestone bearing rock result in the formation of the Alkaline soils.

The Basaltic rocks form the black soils or the Chernozems.

B) Topograpghy or relief:

This influences the soil formation process in many ways because the slope of the land plays a major role in soil formation.

The steep slope encourages the swift flow of water hinders the peidogenetic progress.

There will be excess of soil erosion on the slopes consequently increasing the fertility at the place of deposition.

The areas with gentle slopes or low relief with good drainage will give rise to some thick and matured soil.

C) Time period:

This is the most important factor on which the maturity of the soil depends.

Given time all the rocks will give rise to the matured soils and if they are disturbed they give the immature soils.

SOIL FORMATION PROCESSES:-

Different climatic regions will be having different soil formation processes because of differential temperature and moisture conditions.

There are four soil formation processes present like

1] Podzolization:-

This process gives rise to the formation of Podzol soils and occurs in cool humid climates of temperate zones that is in the latitudes of 40º - 60º where the rainfall is slightly more.

This is a dominant process taking place in the British isles, [Islands and

surrounding areas] Taiga region and parts of China.

The soils are with a distinct soil profile and are most widely spread soils.

They are not much suitable for cultivation because of extensive leaching.

They support the dense forests having deep root vegetations.

2] Laterization:-

This process produces the laterite soils and is common in humid, equatorial, tropical and sub-tropical regions.

These soils are rich in minerals like alluminium and iron but poor in the organic matter because of intense leaching.

These soils form in alternating high temperatures and high rainfall.

They are red or brown in colour due to presence of iron oxides.

They are highly porous soils but in agricultural point of view, they are very poor. [The dampness and high temperatures combine to produce a luxuriant growth of microbes, insects and earthworms etc which aerate the soils].

These soils get converted into the Bauxite and Hematite ores.

3] Salinization:-

This process gives rise to the formation of the alkaline soils.

It is a dominant process of the arid regions where evaporation exceeds the precipitation.

The organic layer is almost absent because of the non-availability of the vegetation.

The water percolates deep into the soils because of sandy nature.

So, the top soils are dry.

Because of the high temperatures, the waters of deep layers come to the top through the capillary action and giving a salty layer on the crust.

They are not useful for the agricultural purposes.

The mineral content is good but lacks the plant nutrients.

When they are supplied with the plant nutrients and the water, they can be converted into the productive soils.

4] Gleisation:-

This process gives rise to the formation of the peaty soils.

This is the process of cool dry regions where drainage is poorly developed.

In the water logged conditions, the bogs and marshes are developed.

There is no humification taking place because of lesser biological activities. [In hot humid areas, if the water logging conditions are seen, we can observe the insitu gasification due to the microbial activity and the soil becomes acidic in nature].

SOIL CLASSIFICATION:-

The earliest scientific classification was given by V.V.Dokuchaiev which was based on their origin and development to which K.D.Glinka expanded the concepts of horizons and the soil profile.

Both of these were the Russian Pedologists.

C.F.Marburt of United States Department of Agriculture gave a modern classification based on the Russian pedological views.

MARBURT'S CLASSIFICATION:-

He divided the soils of entire world into three orders that is

1] The Zonal Soils:-

These are the soils formed in well drained areas with constant climate.

These are in the form of huge and extensive soil belts.

They are more prominent on the earth surface.

These soils are formed in uniform pedogenic conditions which are not disturbed for longer times.

They are highly matured soils having distinct soil profiles.

The zonal soils are divided into four groups or four sub orders like

A) Podsols:

There are four types of podsols namely-

a)Podsols, b)Brown podsols, c) Grey Brown podsols d) Red Yellow podsols.

These are the forest soils present in the cool humid or sub-humid conditions.

They support the temperature or coniferous forest vegetation.

B) Laterites:

These are of three types-

a) Laterites, b) ReddishBrown laterites, c) Black and Dark Grey laterites.

These are the tropical or equatorial soils formed in alternating high temperature and high rainfall conditions.

They support rainforest vegetation.

C) Chernozems:

These are of four types-

a) Chernozems, b) Degraded Chernozems, c) Reddish Brown Chernozems or Chestnut chernozems, d) Reddish prairie chernozems.

These are the soils of temperate regions where warm sub-humid or semi-arid conditions are formed.

They are called as the Bread Baskets of the world, suitable for wheat cultivation.

They support the Grassland vegetation.

D) Desert soils:

There are of three types-

A) Seirozems or yellowish grey desert soils.

B) Red desert soils.

C) Brown desert soils.

These are the soils of hot arid regions where evaporation exceeds the precipitation and they support shrub, bushy or thorny vegetation.

2] Intra-Zonal soils:-

These are the soils formed under poorly drained conditions where water logging is present.

It is a local phenomena and hence these soils are formed in the form of small patches within zonal soils.

They are divided into three groups or sub orders namely-

A) Hydromorphic soils:

These are the soils generated or formed exclusively in water-logged conditions and they are called differently in different latitudes.

They are called ad Peaty or Bog soils in the lower latitudes.

They are called as meadows in the temperate latitudes.

Alpine meadows in the higher latitudes and Planosols in the Tundra region.

B) Halomorphic soils:

These are the soils formed in water logged conditions having dissolved salts.

For example, Salines or alkalines.

They are called Slooths when the salt concentration in the water is more.

C) Calcimorphic soils:

These are also called as Rendzina soils.

They are rich in Calcium.

When the calcium rocks get dissolved, they will be forming these lime soils.

3] Azonal soils:-

These are thin immature soils where the soil formation process is not yet completed.

The profile of these soils is not well developed.

These are the soils formed on the recent volcanic eruptions.

If allowed and given time they may develop into the well developed zonal soils.

They are divided into two groups-

A) Rigosols:

These are the transported soils though they are lacking the soil horizons or profile, they are mineralogically very rich soils and also very fertile in nature.

B) Lithosols:

These are the mountain soils.

The soil formation taking place on the slopes of the mountains will not be matured.

Because of the available slope, it will not be remained there for longer time.

COMPREHENSIVE SOIL CLASSIFICATION SYSTEM:-

This system not only recognizes the origin and development of the soil but also gives equal importance to the human activities for the certain soil derivations like the agricultural activities, application of the lime, use of fertilizers and the accumulation of the agricultural wastes etc.

It uses the terminology with large number of newly coined words to give intended meaning with respect to the properties or the genetic factors relating to the soils.

It is a six tiered or six level classification system with 10 orders, 47 sub-orders, 185 great groups, around 1000 sub-groups, more than 500 families and more than 10,000 species.

This classification is also called as the Soil Taxonomy.

Orders:-

1] Entisols:

These are the soils lacking the horizons.

Generally they are the transported soils which are present because of the accumulation or deposition into certain depressions [Alluvial soils].

2] Inceptisols:

These are the soils having weakly developed horizons and contain lots of weatherable or weathered minerals that is the Regolith.

3] Histosols:

These are the soils with thick layer of the organic matter.

Generally, these are the forest soils consisting of Humus.

4] Oxisols:

These are very old soils present in the lower latitudes.

They are the matured soils with well developed horizons.

5] Ultisols:

These are the very well developed soils of the warm temperate regimes.

Generally they are the chernozems.

6] Vertisols:

These are the well developed soils of the sub-tropical and tropical zones having high clay content.

They are developed deep and wide creeks when they are dry and when wet, they become sticky.

Showing the evidence of the movement of the salts between soil aggregates.

7] Alfisols:

These are the well developed soils of the humid and sub-humid climates.

There is a well developed zone of illuviation present.

These are the Lateritic soils or Laterites.

8] Spodosols:

These are the well developed soils of spodic zone of illuviation.

They are very pale and sandy soils.

The pale colour is due to the removal of Iron oxides and clay.

9] Mollisols:

These are the soils of mid latitudes with thick dark coloured surface horizon.

This is because of thick humus formation.

The structure is many a times blocky and sometimes may be granular.

This may be the podsols soils.

10) Aridisols:

These are the soils of dry climates with maximum accumulation of soluble salts, without the zone of illuviation.

MAJOR SOIL GROUPS OF INDIA:-

Geologically, the Indian soils can be broadly divided into two main groups.

1) Soils of peninsular India.

2) Soils of the extra peninsular India.

Soils of peninsular India are those which have been formed by decomposition of the rocks insitu that is the soils are directly formed from the underlying rocks.

These are the least transported soils called as sedentary soils.

They are least fertile in nature.

On the other hand, the soils of the extra peninsular India are formed due to the depositional work of the rivers.

They are the Transported soils or the Azonal soils.

The Indian Council of Agriculture and Research has setup an All India Land and Soil Survey Organizing Committee in 1953 which divided the Indian soils

into 8 major groups.

Even the United States Department of Agriculture system called as the Soil Taxonomy has been recommended for adoption in India from 1969, which is very technical and hard to remember with more than 260 species of soils in India.

The soil types in India:

There are 8 major groups or types including :

1. Alluvial soils
2. Black soils
3. Red soils
4. Laterite soils
5. Mountain or forest soils
6. Arid or desert soils
7. Saline or alkaline soils
8. Peaty or marshy soils

Alluvial soils:

They account for 45.6% of the total soils of the country i.e., to an extent of 15 lakh sq.km. These are the most fertile soils which are light coloured without any stratification. They are found in two locations.

a. In the extensive stretches of indo-gangetic plains

b. In the deltaic depositions of peninsular India.

They are the most fertile soils because they are transported soils i.e., their genesis is making them more fertile and also because of their frequent renewals. The texture is loamy but it will be ranging from loamy to silty to clayey. They are quite rich in chemical and mineral compounds and also in plant nutrients like potassium and phosphorus. But they are deficient in nitrogen and calcium. They are porous in nature, hence less water retentive in nature. In Ahmadabad, they are called Goradu. In baroda, the older alluvium is called Gorat and new alluvium is called Bhata. In northern plains, the new alluvium is called Khader. In Punjab and Haryana, they are called as betlands.

Major crops grown in these soils are the wheat and paddy. The other important crops grown are sugarcane and tobacco.

Black soils:

They are also called as regur soils locally. They occupy 16.6% of the total soils to an extent of 5.46 lakh sq.km. In general, these are formed due to the weathering of basaltic rocks but they are also formed from the ferrigenous., gneiss and schists. The black colour is due to the presence of titaniferous magnetite. They are water retentive in nature yet the water is not available to the crops. This is because of its fine texture. These soils are ideal for dry land farming or the rain fed agriculture. These soils expand during the rainy season and contracts during summers. This is because of large quantities of soluble salts present. Most of these soils are hygroscopic in nature. Hence, they become sticky or muddy. They are rich in potash, aluminum, calcium, iron, magnesium. The degraded black soils are called chopans in Maharashtra. These soils are good for cotton cultivation and even the millets like jowar, bajra along with the ground nuts are grown. Under irrigation, wheat and sugar cane can also be cultivated. These are found in a compact track on the deccan plateau in the states of Gujarat, M.P, Maharashtra and northern telangana.

Red soils:

They are the most extensive and widely scattered soils of India accounts for 10.6% of the total area to an extent of 3.5 lakh sq.km. They are formed from the igneous or metamorphic rocks like the granites, gneiss, schists, sand stones etc., The color may range from red to yellow. The redness is due to the coatings of ferric oxides on the soil particles rather than to a higher %age of iron content. They turn yellow when the ferric oxides get hydrated (limonite). They extend between katchch in the west to Jhansi in the north to rajmahals in the east and kanyakumari in the south. The texture is highly variable. Rf effects the soil pattern. If high rf, the soils are loamy and these are present in A.P, TN & Orissa. These are used for growing rice and ragi crops. In AP, tobacco is also grown. In the areas of less rf, the soils are coarser in nature present in Karnataka and are used for growing potatoes. The prominent red soils are present in the interiors of TN & Karnataka. They are poorer in nitrogen, phosphorus and humus content, thpugh the red soils are inherent soils. The red soils of WB are the transported soils (from the hills of chotanagpur plateau).

Laterite soils:

These are similar to the red soils but differ in the size of the soil particles (bigger in size). These soils are formed under the peculiar conditions of

alternating high temperatures and high rfs in the tropical and subtropical regions. Because of the high rf, the soil leaches leaving the oxides of aluminum and iron. The soil is blocky in structure due to the presene of iron and it is very poor in lime, magnesium and nitrogen contents. Hence, they are infertile in nature. They respond to the fertilizers and are good for the horticultural crops like coffee, cashew, coconut, rubber and pepper. They are present in small patches on the hill summits or the mountains of the western Ghats and eastern Ghats in parts of Kerala, Karnataka, AP, WB, Orissa, bihar, Assam and Meghalaya.

Mountain or forest soils:

They account for 8.67% of the total soils to an extent of 2.85 lakhs sq.km. These soils are distributed in the Himalayas and also in the upper reaches of milgiris and cardamom hills. They are not fully matures soils because they develop along the slopes. They are rich in humus content but because of slow decomposition of plant material, they cause acidic conditions. They are ideal for garden crops like apples and apricots and horticultural crops like tea, coffee and the flowers(tulips and saffron).

Arid or desert soils:

They account for 4.32 % of the total soils extending for the 1.42 lakh sq.km. These are the soils with pale color may be brownish or yellowish. These are not suitable for agriculture because of the presence of increased% of soluble salts and lesser water holding capacity along with poor nutrient base. If the nutrients and irrigation are supplied they become productive in nature. The salts which are present in huge quantities are non-toxic in nature. Generally, they are acolian in origin and bajra is the predominant crop grown.

Saline or alkaline soils:

Two types:

a. natural: These are associated with the coastal plains.

b. man-made: These are associated with intensively canal irrigated areas.

The water table is already high in the indo-gangetic plains and along with it, there is large scale seepage from un lined canals. During the summer, the water rises up through the capillary action and evaporates leaving behind a layer of salt. Because of white encrustation of the salts, the saline soils are called as white alkalis. If the soil contains large amount of neutral salts with

increased %age of Na2CO3, they are called as sodic soils or black alkalis. They are nitrogen deficient in nature, the addition of gypsum and washing with water helps the soil reclaimation.

Local names- white alkalies, thur, shora, kari, khar, loni, soulu, pokkati etc.,

In some of the areas, they are also called as ushar, mallar, reh, bari, kshar.

Sodic soils: Rakkar, bara, usar, karh, chopan.

Peaty soils or marshy soils:

These are formed in the humid climates where the drainage is bad or poorly developed. The soils are immature with large amounts of organic content. They are not fit for agriculture because they develop in water logging marshy conditions. The insitu gasification process occurs because of the abundance of undecomposed organic material. Under anaerobic water logged conditions, bluish or grayish coloured soils are formed.

Soil erosion:

It is the removal of soil particles by natural agents like the torrential rains, running water, strong winds, mighty moving glaciers and also on the nature of the soil. It is a natural process but goes unnoticed and it is the resultant of a number of factors working in isolation or in association with one another.

The soil erosion is of 3 types:

1. Sheet erosion:

The upper layer of the soil particles are removed in the form of a thin layer or a sheet. It is a universal process and of most serious type. This takes place more or less continously but goes undetected.

2. Rill erosion:

When the soil erosion gets concentrated along the channel of a run off or along the streams or rivers, thread like grooves or shorter V shaped valleys are formed which are called as rills.

3. Gully erosion:

The intensification of the rill erosion is known as the gully erosion which leads to the ravine formation, which is called as the badlands. They are the

common features seen in the Chambal region.

Human factors in soil erosion:

Human is an important factor responsible for soil erosion. Though it is a natural process, it has been accelerated by the ill judged activities of humans like deforestation, over grazing and faulty agricultural methods. The soil erosion is a serious national problem which is created and faced by the human itself.

1. Deforestation:

The deforestation is reckless cutting of the trees and this is resulted due to the increased stress on the forest resources because of increased population. The roots of the plants and trees bind the soil particles because they absorb the moisture and falling rain drops are stopped from their direct attack on the surface soils. They also regulate the water flow and when they are cut, all of these activities are exposed. The soil erosion due to deforestation is maximum in M.P, Rajasthan, Punjab and Haryana.

2. Over grazing:

The forests and grass lands provide much needed fodder for the animals.In the rainy season, the grass is plenty but in long dry seasons, the grass is grazed to the ground and is torn out by the roots from the ground. This loosens the soil structure and can be easily washed away by the rains or blown away by the winds. The sheeps and goats prove detrimental for the top soils and the erosion by sheeps and goats is very common in the hilly areas of J&K and H.P & in the dry areas of Rajasthan, M.P, Maharashtra, Karnataka, A.P.

3. Faulty agricultural methods:

Large scale soil erosion in India is due to the faulty agricultural methods and important being the ploughing, lack of crop rotation and shifting cultivation. The ploughing is many times parallel to the slope and also to the wind direction which will be accelerating the soil erosion. When a single crop is grown year after year, it spoils the chemical balance of the soil due to which the soil gets exhausted and is easily eroded. The shifting cultivation is causing soil erosion in the north eastern India and the tribal belts of AP, Orissa, MP, Maharashtra, TN, Chhattisgarh etc.,

Extent of soil erosion in India:

The soil loss in India is assuming alarming proportions. A part of the problem is largely because we have about 45% of the land under cultivation. The soil loss will be leading to loss of nutrients and also the siltation of the tanks and the reservoirs. Out of the 320 million hectares of total area of India, around 80 million hectares or $1/4^{th}$ is exposed to the wind and water erosions. Of this 40 million hectares of land has undergone serious erosion which is permanent loss to the cultivation. Around 45 million hectares of land is subjected to severe wind erosion in Rajasthan and its adjoining areas due to which around 34 lakh tons of fertile soils are removed by winds every year in these arid and semi arid areas.

Because of the faulty agricultural methods, overgrazing etc., in the past 100 years around 8 million tons of soil has been removed from every sq. km of the country. The water erosion is more active in the wet areas receiving more rf, having the steeper slopes, where the vegetation is scarce etc., According to the ICAR estimates, the loss of soil by water erosion is 53.34 million tons per year. A working group set up by ICAR and the ministry of home affairs in 1971 estimated that around 39.75 lakh hectares of ravines are spread in 18 of the states and 70% of which are spread in only Rajasthan, Gujarat, UP & MP.

The shifting cultivation is causing the removal or clearing of forest land of more than 15 lakh hectares per year. The total area affected by it is ranging between 40 to 50 lakh hectares. In south India, along the nilgiris and the eastern slope of the western Ghats, the soil erosion is due to the potato cultivation. About 6.8 million hectares of soil is turning non productive due to the salinisation in the states of Punjab, Haryana and western UP. The coastal erosion i.e., by the wave attacks is the other form of causing constant erosions and it will be a ten fold increase during the cyclones and storms.

Effects of soil erosion:

1. It causes the loss of soil fertility leading to the fall in agricultural productivities.
2. The leachings result in the loss of mineral nutrients.
3. The ground water level is lowered decreasing the soil moisture.
4. The natural vegetation cover gets dried up and the arid lands expand.
5. The frequency and the intensity of the floods and the droughts will be increased.
6. The carrying capacity of the channels, rivers and streams will

decrease, even decreasing the storage capacity of the tanks, reservoirs etc.,

7. It causes the land slides. On the whole, the entire economy of the country suffers leading to great setbacks.

SOIL CONSERVATION:

It includes all the measures taken which help in protecting the soil from erosion and exhaustion. The healthy agriculture is bound up with healthy soil. Soil is the most precious asset and an essential gift of nature to the humans. Hence, soil conservation is a must for the survival of the human race.

The chief agents of soil erosion are the water and wind. In general, the following methods are normally adopted for soil conservation.

1) Deforestation: - The best way is to increase the area under forests because, the roots will bind the soil particles because they absorb the moisture. The canopy absorbs the shocks of the falling water, the stems reduce the run off increasing the ground water level etc.,

The forest cover should be maintained at 20% for the plains and 60% for the hills.

2) Checking overgrazing: - This specially causes the loosening of surface soil enhancing the acceleration of erosion. The over grazing by sheep's and goats should be checked.

Separate grazing grounds should be year marked, and a large quantity of the fodder crop should be grown. (There is the lack of extra land because of the bourgeoning population). We require more land for the agricultural purposes itself.

3) Dam constructions: - The constructions should be made across the rivers which will be checking the speed (or) the velocity of the waters, thereby saving the surface layers.
4) Changing agricultural practices

By changing this we can save a lot of soil and these may be

a) Adopting crop rotations: The same crops grown year after year takes away only certain elements making the soil exhausted of particular nutrients. Thereby disturbing the soil balance. If we go for the crop rotation the replenishments of the soil nutrients takes place making it

to be a more balanced one.

b) Strip cropping system: The alternate cropping of erosion inducing crops with the erosion resisting crops is strip cropping. At no point of time the entire land is left bare or exposed, thereby reducing the soil erosion.

Even in the desert areas, the shelter belt plantation is also sometimes referred to as the strip cropping.

c) Checking shifting cultivation: This is done by persuading the tribes to switch over to the settled agriculture. This can be done by making arrangements for their settlements and by providing agricultural implements, seeds, manure and cattle etc.,

5) Terracing and contour bunding: This is done across the hill slopes and very effective and the oldest method of soil conservation. These two methods divide the hill slopes into numerous small slopes which check the water flow and promotes water absorption.

Terracing is producing the flat land conditions artificially and contour bunding is construction of small check dams.

6) Contour ploughing: The ploughing of the land along the contour or across the slopes will be helpful in checking the water flow, reducing the wind velocities and protecting the soils from erosions.

NATURAL VEGETATION

FORESTS:

The word 'FOREST' has been derived from a Latin word 'fores' which means 'the land present outside to the village boundary or the fence'. The modern definition says that it is an area set aside for the production of timber and other forest produce for human benefits. Indian definition includes the conservation of wild life.

THE FACTORS INFLUENCING VEGETATION:

There are several geographical factors like climate, soil, topography, altitude and slope etc., which influence the natural vegetation.

CLIMATE:

Though the climatic variables include both the temperature and rainfall, the rainfall is given maximum importance for the natural vegetation. Because ours is a tropical country the variation in temperature will be minimal. In the higher altitudes of Himalayas and the hills of peninsular India at elevations of

more than 900 mts the temperature plays the major role. We know that temperature falls within the altitude changing the vegetal cover in the Himalayas. It will be from the tropical to sub-tropical, to temperate, to coniferous and finally to alpine. The slopes which are facing the sun have got good natural vegetation and the ones which are away have got least or no vegetation.

TOPOGRAPHY :

Topography in narrow sense is responsible for certain minor types of forests like alpine and littorals etc., At present India has got 23.43% of the natural vegetation where as the forest cover is only 21.8%.The green India mission aims to increase the vegetative cover of India from 23 to 33%. In the last 10 years, it has brought 4 lakh hectares of area under the forests and wants to get the same in next 5 years.

For general convenience of the people and the students the forests of India are divided into the following 5 types.

1. Tropical evergreen
2. Tropical deciduous
3. Thorny forests
4. Coniferous forests
5. Littoral or the mangrove or the swamp forests.

FOREST CLASSIFICATION:

It is a very difficult job because of a variety of vegetation present in India. This is very normal because of the varied climatic conditions, the geological conditions and the physical conditions.

H.G.CHAMPION in 1936 distinguished 116 types of vegetative groups present in India. This was much simplified by G.S.PURI in 1960, LEGRIS in 1963, CHAMPION and SETH in 1968 and NEGI in 1990. Based on the suggestions given by these scholars the Indian vegetation is divided into 5 major types with 16 sub-types. The major types are represented by the capital letters i.e., A,B,C,D,E.

A. Moist or wet tropical forests with 4 sub-types.

B. Dry tropical forests with 3 sub-types.

C. Montanne sub-tropical forests with 3 sub-types.

D. Montanne temperate forests with 3 sub-types.

E. The alpine forests with 3 sub-types.

A. MOIST TROPICAL FORESTS:

Also known as evergreen forests.

1. Tropical wet evergreen forests:

These are the typical rain forests which grow in those areas where the annual average rainfall exceeds 250 cms. The annual average temp is about 25^{o} to 27^{o}C and the humidity exceeds 77%. It consists of lofty very dense multilayered forests where the trees are reaching to a height of 45 to 60 mts. The sun cannot reach the ground surface due to the thicker canopy. The undergrowth is tangled by ferns, bamboos, canes and woody climbers called LIANAS. The timber of these forests is fine grained, hard and durable with high commercial values. These forests are present in the Western Ghats, Andaman & Nicobars and in the north eastern states. The species present are MESUA, CEDAR, TOON, DHUP, HOPEA etc., in western Ghats and in the north east we find GURJAN, CHAPLASHA, JAMUN, AGAR, MULI etc.,

2. Tropical semi evergreen forests:

These are the forests present bordering the areas of tropical wet evergreen forests which receive the rainfall ranging between 200 to 250 cms. The average annual temperature is ranging between 24^{o} to 27^{o} C with the humidity of 75%. These are the less dense forests and represent a transition between the tropical wet evergreen forests and deciduous forests. Many species are present with buttressed trunks having rougher and thicker barks due to which they have abundant epiphytes. These forests also have heavy climbers. They are present in the Western Ghats, Assam and the eastern Himalayas, Orissa and Andaman and nicobars. The species present in Western Ghats are AINI, SEMUL, GUTUL. KADAM, ROSE WOOD and INDIAN LAUREL. In the north east CEDAR, CHESNUT, CHAMPA etc.,

3. The tropical moist deciduous forests:

These are present in the areas receiving a moderate rainfall ranging between 100 to 200 cms and the average annual temperatures are more than 27^{o} C and the humidity 60 to 75%. The trees of these forests drop their leaves for about 6 to 8 weeks per year during spring and early summer. The forests become evergreen with monsoons. These are very useful forests because

they yield valuable timber and are easy to exploit. Much of the forests are cleared for cultivations. They are present on the western and eastern slopes of Western Ghats, shivalik ranges, chattisgarh, chota Nagpur plateau, Orissa and west Bengal. The important species are teak, sal, rosewood, mahua, kusum etc.,

4. Littoral or swamp forests:

The forests which are present in and around the water logged or marshy conditions are called swamp forests and if they are around the estuaries, deltas and creeks along the coasts, they are called as littoral forests.

The peculiar features of the littoral forests are that they can survive and grow both in the fresh as well as brackish waters and the roots are ageotropic in nature. They provide hard and durable timber for the building and construction purposes and also for making boats. The littorals are present on the deltas of the eastern coasts. They are called sundarbans in the gangetic delta. In Krishna Godavari delta they are called koringa forests. These forests account for around 7% of the world littorals. The species present are sundari, bhendi, nipa, rhizophora and screw pines etc.,

B. DRY TROPICAL FORESTS:

5. Tropical dry evergreen forests:

These are present in the areas receiving a rain fall of around 100 cms where the annual average temperatures present are 28^{o} C with the humidity of 75%. The growth of the evergreens at such low rainfall is difficult to explain. The forests are short statured and they grow upto a height of 12 mts with complete canopy. There is no differential layered growth (the evergreen forests present here are due to the cloudy summers and the rainy winters) and mostly present on the coasts of Tamilnadu. The important species present are khirni, kokko, tamarind, neem, canes, gamari, machkund etc.,

6. Tropical dry deciduous forests:

These are the forests present in the areas receiving a rainfall between 100 to 150 cms where the annual average temperatures of 28^{o} C are present with humidity of around 50 %. They represent a transitional type between moist deciduous and thorn forests. Enough light reaches the ground and permits the growth of grasses and climbers and they are widely distributed over areas large of our country. They occur in an irregular wide strip running north south from the Himalayas to the kanyakumari except in rajasthan, parts of Punjab,

Haryana , west bengal and western ghats. The imp species are rosewood teak, sal, tendu, khair and palas etc.,

7. Tropical thorn forests:

These are the forests present in the areas receiving a rainfall of less than 75 cms where the average rainfall temperatures are fluctuating between 25° to 30° C and having less than 50% of humidity. The trees are low and widely scattered and will be slowly degenerating into the desert type. The acacias are very prominent along with Indian wild dates and these forests are present in Rajasthan, South West Punjab, Western Haryana, kachch and the leeward side of Western Ghats. The important species present are neem, babool, dhaman, cacti and thor.

C. MONTANNE SUB TROPICAL FORESTS:

8. Subtropical broad leaved hill forests:

They grow in the areas where the rainfall is ranging between 75 to 125 cms and the temperatures of around 18° to 21° C the humidity is high and is around 80%. These are the luxurious forests consisting of evergreen species. They are fairly high and also dense. Most of these forests are destroyed and changed beyond recognition and are present in eastern Himalayas in the altitudes of 1000 to 2000 mts. The species are oak, chesnut, pines etc.,

9. Subtropical moist pine forests:

They are grow in the areas having the rainfall between 75 to 125 cms where the average temperatures are between 18° to 21° C and the humidity is more than 85%. Chir is the dominant tree which forms the pure strands and have provided the timber for the furniture, boxes and railway sleepers and they are also known for supplying the resin and the turpentine oil which is used in the paint industries. These forests are present in western Himalayas, parts of Nagaland, Manipur, arunachal Pradesh.

10. Subtropical dry evergreen forests:

These forests grow in very restricted areas receiving a rain fall of 50 to 100 cms. The summers are hot and the winters are cold with permafrost conditions. These are the low forests practically they are the scrub forests having thorny bushes and grasses present in bhabars of shivaliks and in the western Himalayas upto a height of 1000 mts. The species present are olive,

acasia, creeping palms and nonnor pops.

D. MONTANNE TEMPERATE FORESTS:

11. Montanne wet temperate forests:

These are the forests present in the areas having the rainfall ranging between 150 to 300 cms and the temp is between 11 to 14^{o} C and humidity of more than 80%. These forests grow in the heights ranging between 1800 to 3000 mts. These are closed evergreen forests with short branchy trees where the trees are rarely achieving a height of more than 6 mts. They have large girths and leaves are dense and rounded. The woody climbers are very common along with the mosses, ferns and the other epiphytes present in the higher hills of tamil nadu, kerala and the eastern Himalayas in Sikkim, arunachal Pradesh and assam. The species present are deodar, chilauni, chesnut, birch, magnolia, oak, hemlock and blue-pine etc.,

12. Himalayan moist temperate forests:

These are present in the areas having rainfall between 150 to 250 cms and temperatures of around 15^{o} C. They are present in temperate zones of Himalayas in between 1800 – 3000 mts of height. They are mainly composed of the coniferous species but they are fairly open forests with the undergrowth in the form of rhododendrons, bamboos etc.,

The deodar dominates on the comparatively drier western parts and in the wetter eastern parts. The conifers dominates like pine, cedar, silver fir, spruce etc.,

13. Himalayan dry temperate forests:

These will be getting the precipitation from the south west monsoons but in the form of snow. The precipitation is very feeble and always less than hundred cms. These forests are present in ladakh of j&k, lahul and chamba of HP, koinnaur and gharwal of uttarakhand and in Sikkim.

E. ALPINE FORESTS:

They occur all along the Himalayas at the altitudes ranging between 2900 to 3500 mts and sometimes even upto an altitude of 3800 mts and there are 3 sub types present.

14. Sub alpine forests:

These are found at the upper limit of the tree forests with a mixture of coniferous woody trees, large shrubs and small crooked trees. The broad leaved trees never reaching more than 10 mts of height. The species present are fir, spruce, kail, plumb and rhododendrons etc.,

15. Moist alpine forests:

This is a low evergreen forest having a dense growth of rhododendrons and they occur over 3000 mts of height. Other than rhododendrons, birch, barberries and honey suckle etc., are present.

16. Dry alpine scrubs:

This is the uppermost limit of the vegetation which is in the form of xerophytic dwarf shrubs and present over the ht of 3500 mts. The important species are juniper, Artemisia and potentilla etc.,

Apart from the major classification of Indian forests described earlier they are also classified on the basis of status, ownership, composition and exploitability etc.,

CLASSIFICATION BASED ON STATUS:

This classification is also called as legal or administrative classification. This is to protect the forests against the indiscriminate destructions. These are the forests maintained for regular wood supply i.e., for the forest products and for ecological reasons. They are the permanent forests.

Legally these forests are categorized into 3 types:

1. The reserved forests
2. The protected forests
3. The unclassed forests

The reserved forests:

They account for 54% of the total forests in India. These forests enjoy higher degree of protection and security. Even the activities like grazing are also not permitted into it because of their rich resources and diverse wild life. They are gradually declared as the wild life sanctuaries and the national parks. The term reserved forests was introduced in 1927 by the british-indian government. Now the respective state government have the distinction to declare the reserved forests.

The protected forests:

They account for 29% of the total forests in India and are further divided into the demarcated and the undemarcated forests. In these forests, some types of human activities like collection of the minor products and hunting of the small game and the grazing of their cattle are allowed.

Unclassed forests:

They account for 17% of the total and these are unprofitable forests which have become largely degraded and unproductive in nature.

Classification based on ownership:

Most of the forests in India are owned by the government to the department of forestry. But less than 1% are owned by the corporate bodies & the private persons. These are present in Punjab, Haryana, Assom, Meghalaya & Orissa.

Classification according to composition:

According to composition of trees, the forests are of two types.

1. Coniferous forests: Only 3.5% of the forests in India are coniferous in nature. These are not properly exploited because of the difficult terrain and lack of transportation facilities. They are known for soft wood.

2. Broad-leaved forests: They account for 95% of total forests. The important Species belong to hard wood type. These are commercially very valuable. They are under degradation.

SOCIAL FORESTRY

Main aim of the social forestry is the management and the protection of forests as well as aforestration of barren lands along with helping the environmental, social and rural developments.

The term ‘social forestry’ was used for 1st time in 1976 by the national commission on agriculture & it recommended to the government of India for the introduction of this concept into the 6th five year plan. This concept was inducted and taken up in the subsequent plans also.

It is the raising of plantations by the common man for the common man to meet the growing demands of timber, fuel wood, fodder and also the urban

recreation like city parks.

This is done in unused and fallow lands and along the roads, railways and canals.

The social forestry is said to be “the forestry of the people, by the people and for the people”

Agroforestry;community forestry; commercial farm forestry;non-commercial farm forestry; urban forestry are the main components of social forestry.

1. Agro forestry:

This involves the raising of the trees & agricultural crops either on the same land or in close association and in near proximity. The land gives maximum production i.e., the farmer gains double benefit both by the crops and plants.

* this is also said to be the maximum utilization of land resources for maximum production and for providing employment.

* the agro forestry even includes the growing of trees on the waste patches like the boarders of the land holdings which are put into good use.

* this enables the farmers to get food, fodder, fuel, fruit and timber.

2. Community forestry:

This includes the raising of the trees on public or community lands for providing benefit to the community as a whole.

3. Non commercial farm forestry:

This involves the plantations by farmers on their own land for their own use. The waste lands, the marginal lands and the court yards along with the cowsheds are used. These plantings are not for sale.

4. Commercial farm forestry:

This involves growing of trees in the fields in lieu of food crops. Instead of food crops and the other agricultural crops this is for direct commercial gain.

5. Urban forestry:

This is related raising and management of trees on the public and privately

owned lands in and around the urban centers. It includes the green belt plantations, the road side avenues, the recreational parks and the wild life parks within the city limits etc., the main objective of the urban forestry is to reduce the environmental pollution and also to improve the aesthetic values along with the recreations.

Forest cover in India:

The statistics regarding the forests are provided by forests survey of India, dehradun which are as follows:

1. The total natural vegetative cover in India is 23.43 % of which 2.79% is the tree cover and the forest cover is 21.89%.

2. The real forest cover in India is about 16% and the rest is under degradation.

3. The world's average forest cover is 30.4% (Canada-34.4%, Germany 36%, USA- 41.07%, Sweden- 57.8%, Japan- 67.7 %) .

4. The geographical distribution of forests in India is very uneven with peninsular India accounting for 57%, the Himalayas 18%, northern plains 5%, the western Ghats , the eastern along with their plains account for 10% each.

5. The national forest policy suggests for at least 33.3% of the country should be covered by the forests for ecological balance with hilly areas accounting for 60% and the plains with 20%.

6. The largest area under the forest cover is in M.P.- 77,265 sq.km, Arunachal Pradesh 68,045, Chhattisgarh-56448, Orissa-48838, Maharashtra 47482, Andhra Pradesh 44637.

7. The area under the scrub forests is largest in Andhra Pradesh.

8. The least forest cover within the state is accounted by Haryana 3.53%, Punjab 6.07%, Gujarat 9.06%, and Rajasthan 9.54%.

9. The percapita availability of the forest land is 0.07 hectare per head (USA 1.8, Sweden 3.2, Russia 3.5, Brazil 8.6, and Canada 22.7.).

10. The productivity is very low. It is only 7.5 cubic ft per hectare (Japan 92.5 cubic feet, France145 cubic feet)

11. The forests are accounting for less than 1% of GDP in India.

USES OF FORESTS:

FOREST PRODUCTS:

Forests constitute one of the major natural resources of India. They produce a large variety of products and are broadly classified into two categories. They are

1. Direct uses

2. Indirect uses.

The direct uses are in the form of products

The indirect uses are the life saving devices. (both are same)

DIRECT USES:

This constitutes the major forest products and the minor forest products.

MAJOR FOREST PRODUCTS:

The commodities which are obtained from the forests by harvesting the trees are known as the major forest products and they consists of the timber which we will be getting by cutting the trees and they may be the small wood, fuel wood including the charcoal. The Indian forests produce about 5000 species of trees and wood of which only 450 species are commercially valuable. The hard wood which we get from the forests include teak, mahogany, log wood, iron wood, ebony, sal, semal etc., and most of these are used in making the furniture, tools, wagons etc., Our forests also give the soft wood like deodar, pine, popolar, fir, cedar, balsam etc., The soft is light, strong, durable and easy to work. They also provide useful raw materials for making of paper pulp and construction timber. 70% of the hard wood is used as the fuel and only 30% is used in the industry and it is vise-versa for the soft wood. The forests meet about 40% of the energy needs of the country including more than 80% of the rural energy. Whatever is the current food production, it is short of demand. This is because of large scale industrialization and restriction of forests products.

MINOR FOREST PRODUCTS:

The commodity which is obtained from the forests without harvesting the trees i.e., all other products than the wood containing both the animal and

vegetative origin are known as minor forest products. They include

Grasses :

Most of the grasses which are used in the paper industry are from the sub-himalayan tracks and they include sabai, salai, bhabar and elephant grass.

Some of the grasses are also used in making the chairs and the stools. Example: munj grass

The roots of khus grass are used in making of cooling screens.

Bamboo:

It is a grass but grows like a tree and we have more than 100 species of bamboo present and it is called as poor man's timber. Bamboo is used for roofing, walling, flooring, matting and basketry etc., 32% of it is used in construction, 17% in paper industry and 17% in packaging materials and 14% in the other purposes.

Cane:

It is used in making the ropes, strings, mats, bags, baskets, walking sticks, furniture etc.,

Tans & dyes:

These are the secretions which we get from either the plant tissues, fruits or the flowers etc., The tans are used in the tanning industry i.e., for softening the raw leather or hide. The plant tissues of mangrove, amla, oak, hemlock, anwal, ratan jod and the flowers of dhawri babool, avaram are used in the tanning industry.

The bright red dye we get from sander, chocolate dye from khair, yellow dye from the flowers of palas, fruits of mallotus phillipensis and the bark of wattal. Every year around two lakh tonns of tans and dyes are produced in india.

Oils:

Many of the trees gives out the oil which is used in manufacturing of the soaps, cosmetics, confectionaries and also in pharmaceutical preparations. The commercially important oils are obtained from sandal wood, lemon grass, eucalyptus, khus grass etc.,

Gums & resins:

Gums are exuded from the stems or the branches partly natural and partly artificial by injuring the bark or blazing the tree. Karaya gum which we get from sturculia urens, sterculia villosa is used in textiles, cosmetics, confectionaries, medicines, ink, pastes etc., 2010 & 2011 forests exports are around 1800 crores of which 1200 crores of only the karaya gum was exported to USA, UK, france, germany etc.,

We get resins from chirpine of Himalayas i.e., from J&K, H.P, Uttarakhand and Punjab. From this crude we get 25% turpentine 75% resin which is distilled and separated. The turpentine is used as a solvent in paints, varnishes, waxes, polish and as a disinfectant and also as industrial perfume. Resin is an important raw material in the manufacturing of paper, paints, rubber oil, grease, plastics, soaps and adhesive tapes.

Fibres and flosses:

The fibers are all the coarse tissues of the trees which are used in rope making, string and bag makings but the fibers from AK (calotropic species) which is very fine, strong and silky hence used in making the fish nets. Flosses from certain fruits are used for stuffing mattresses, pillows etc.,

Leaves:

Different leaves are used differently in different situations. For example tendu leaves in beedi making. We are the biggest exporters of beedi and importers are pak, afghanistan, sri lanka and other afro asian nations. The leaves of bauhinia are used in making of plates, cups, wrappers which are used by the vendors.

Drugs, spices and poisons:

Thousands of varieties of drugs are obtained from the forests. Quinine is most important drug obtained from the bark of cinchona. Spices are used to add aroma and pungency to the food stuff and they are also important for aphrodisiac. For example cardamoms, cinnamons etc., The poisons in smaller doses acts as good medicines. For example aconite, strychnine, datura, ganja etc.,

Edible products:

Various parts of various species provide the edible products. For example

fruits from mango, apple trees and kernels from cashews, walnut, chilgoza etc., liquors from palm, corolla, mahua etc.,

Animal products:

These come from the forests present in chota Nagpur plateau, the dandakaranya extending in the states of Bihar, U.P, Jharkhand, Orissa, chattisgarh to A.P.

Lac:

It is an insect secretion and india holds monopoly for this product and it is used in the medicines, electrical insulation, paints, wood furnishings, bangle making and in other ornaments etc., We also get honey, wax, silk, horns, antlers etc.,

About 3.5 million people are engaged in forest related activities. 2% of the government revenue comes from the forests. The gross revenue from the forests is far more than the expenditure.

INDIRECT USES:

They are immensely useful for the mankind indirectly.

They act as CO2 sinks and the bio reserves with variety of plants and animals.

They influence the rain producing mechanisms.

They make the micro climate of an area more moderate and equable.

They emeliorate the extremes of climate.

They check the flow of surface water there by controlling and preventing the soil erosion.

They recharge underground water increasing the water table, feed the rivers, lakes, springs, ponds etc.,

They check the spread of deserts by retarding the wind velocities.

They increase the fertility of the soil by adding the humus.

The atmospheric hydrological cycle is maintained by the forests.

Institutions relating to forests:

ICFRE: Indian council for forestry research and education, dehradun:

Is the apex body for forestry having the head quarters at dehradun. Under this several forest institutions are working like

- Forest research instition, dehradun
- Institution of arid zone forestry and research, jodhpur
- Institution of rain and moist deciduous forests, jorhad, Assam.
- Institution of wood, science and technology, bangalore.
- Tropical forest research institute, Jabalpur.
- Institute of forest genetics and tree breeding, coimbattore.
- Temperate forest research centre. Shimla.
- Centre for forest productivity, ranchi.
- Centre for social forestry and environment, Allahabad.

Resources:

Land utilization (LU):

The existing pattern of LU in India is a result of continued inter-play of the physical environmental elements and the human efforts, which are guided by a host of socio economic conditions.

The total geographical area of India is 328.73 million hectares but the statistics pertaining to the LU are available only for 304.84 million hectares i.e., 92.7% of total and this is utilized for different activities like,

1.The net sown area:

This accounts for about 46.6% of the total area of India. The world avg. is 32%, USA-40%, Russia-25%, Brazil -16%, Canada-6%.

During 1950-51, the NSA was only 118.74 million hectares got increased to about 143 mh which means as increase of around 25% of land under NSA. This is much because of the grooves, orchards and the fallow lands have been bought under cultivation. But the percapita availability of land has gone down drastically from 0.53 hectares in 1950-51 to 0.22 hectares in 1991 and to 0.19 hectares during 2001 and it is 0.15 hectares in 2011.

M.P has largest NSA of 17.74 lakh hectares.

Maharashtra-18.02 lakh hectares

U.P-17.25 lakh hectares

Rajasthan-16.23 lakh hectares

Karnataka-10.33 lakh hectares

A.P- 10.32 lakh hectares

The NSA to the total reporting area within the state is highest in Punjab-83.7%, Haryana-80.3%,U.P-62.8%, W.B-60.3%, Maharashtra-58.3%.

2. The area sown more than once:

This accounts for 31% of the net sown area which is 14.5% of the total reporting area of the country (46.6%+14.5%=61.1%)=189.7 million hectares.

- This is the area having rich fertile soils & regular water supply.
- To overcome the food defiency, the area sown more than once should be increased.
- Our 31.1% is much less when compared to china & Bangladesh , which are having more than 90% of their area under this.
- At present, $3/4^{th}$ of Punjab, Haryana, U.P, bihar & 10-30% of Kerala, T.N, A.P, W.B, Rajasthan, M.P & less than 10% of other states & union territories are used more than once.

3. Forests:

The forest area has increased considerably from 40.48 million hectares in 1950-51 to 68.42 million hectares by 1993-94 & by 2010 its marginal increase of 0.5 mh. So with in a span of 60 years, there is an increase of 68% of forest area.

4. Land-not available for cultivation:

This class consists of two types of land forms.

i. The lands put under the non agricultural uses like for the construction of the settlements, transportation arteries and the irrigational infrastructures etc.,

ii. The barren unculturable bases. These include mountains, deserts, rockyplains etc., 13.4% of the total land is not available of which 7.9% comes under the 1^{st} category and the rest under the 2^{nd} category. The maximum land which is not available for cultivation is present in A.P, rajasthan, M.P, Gujarat

and U.P.

5. Permanent pasteurs and the other grazing lands:

About 3.5% of the total land mass is devoted to these activities which is not sufficient for the population of livestock present in our country. For example 23% of the total area of H.P consists of grasslands and in the states like Karnataka, M.P, Gujarat, rajasthan, Orissa, the availability of the grass lands is ranging between 4.66% to 8.54%.

6. Land under miscellaneous tree crops and grooves:

There is a sharp decline of this land from 19.8 million hectares in 1950-51 to 3.60 million hectares in 1990-91 which has decreased further to 3.36 in 2001 and 3.30 in 2011 which is around 1.1% of the total area of the country. This land is present maximum in Orissa, U.P, Karnataka, bihar, A.P.

7. Culturable wastes:

This too had a decline from 22.9 million hectares in 1950-51 to 13.49 million hectares in 2001 to around 13.4mh in 2011 which is accounting for 4.5 % of the total. The maximum culturable wastes are present in goa-15%, bihar-9%, Rajasthan-5.3%. Minimum present in Kerala and north east.

8. The fallow lands:

This is the land kept without utilizing for sometime and accounts to 7.2% of the total reporting area and is divided into the current fallow i.e., the land kept unutilized for 1 year and the other fallows i.e., the lands which are kept fallow for 3 to 5 years. The current fallow is maximum in A.P, rajasthan, bihar, Karnataka and T.N where as the total fallow is maximum in rajasthan , A.P, Maharashtra etc.,

INDIAN AGRICULTURE

Salient features of agriculture:

Indian agriculture has its own peculiarities like

<u>Subsistence agriculture:</u>

Inspite of large scale changes in agricultural practices after independence ours is the subsistence agriculture where the farmer owns small piece of land and grows crops with the help of the family members and is consumed by

them selves.

Pressure of population on agriculture:

Population of India is increasing at a rapid rate and exerting heavy pressure on agriculture because it should feed and provide employment to millions of people. With the present demand we require 12 to 15 million hectares of land additionally to cope the increasing demand by 2050. It is estimated that around 4 lakh hectares of agricultural land is diverted to non agricultural activities per year.

Importance of animals:

The animal force has always played a significant role in the agricultural operations from ploughing, irrigating, threshing till transportation. So, each and every activity of agricultural activities are dependent on animals. The complete mechanization is a distant dream in India because of the poor farmers.

Dependency on monsoons:

The monsoons are uncertain, unreliable and irregular. Inspite of large scale expansion of irrigational facilities after independence they are providing water to only 1/3rd of the cropped area. The rest of the area has to bear the brunt of the natural vagaries.

Variety of crops:

Because of varied relief, climate, soil conditions and the geologies in India, a large variety crops are grown including both the tropical to temperate.

Predominance of food crops:

Since Indian agriculture has to feed a large population, the priority is given to the food crops. During 1950-51 only 76.7 million hectares were allocated for the food crops which have doubled nearly to 125 million hectares by 2010 – 11. 2/3rd of the total area is devoted to the foodcrops.

Insignificant place to the fodder crops:

Although India has largest population of livestock in the world, the fodder crops are given a very insignificant place in our cropping patterns.

Seasonal patterns:

India has 3 major cropping seasons.

Kharif: This season starts with the onset of monsoons and continues throughout the monsoon season till the winter begins. The crops grown during this season are rice, bajra, maize, sesamum, jowar, ground nut, pulses like moong, red gram, tur.

Rabi: It starts with the beginning of winter and continues till the beginning of summer and the crops grown are wheat, barley, jowar, green gram, black gram and oil seeds like mustard, lin seed, rape seed.

Zaid: It is purely summer cropped season and the crops grown are rice, maize, ground nut, vegetables and fruits.

PROBLEMS AND SOLUTIONS:

Indian agriculture is plagued by several problems. Some are natural and some are man-made.

1. SMALL AND FRAGMENTED LAND HOLDINGS:

The seemingly abundance of net sown area of 142.1 million hectares and total cropped area of 189.7 million hectares pales to insignificance. This is because the land is divided into economically unviable small and scattered holdings. The average size of land holdings was 2.28 hectares in 1970-71 which reduced to 1.5 hectares by 95-96. 2010-2011 it is around 1.2 hectares. The problem is much more in densely populated and intensively cultivated areas like kerala, W.B, bihar and U.P where the average land holdings is less than 1 hectare. The maximum of the land holdings are accounted in Nagaland-7.5 hectares (jhumming cultivation), rajasthan-4 hectares (sandy stretches), Punjab-3.77 hectares (fertile cultivable land). The holdings are least in kerala- 0.36 hectares. 59% of holdings in india are marginal (90-91) i.e., less than 1 hectare and accounting for 14.9% of total operated area. 32.2% of them are the small holdings between 1 to 4 hectares accounting for 17.3% of the total area operated. 17.2% are the medium holdings with 4 to 10 hectares and accounting for about 50% of the total area operated and 1.6% are the large holdings with more than 10 hectares of land and accounting for 17.4% of the total area operated. The main reason is our law of inheritance. The distribution of the land does not go as a consolidated package but its nature is fragmented. Due to this a lot of time and labor is wasted in moving seeds, manure, implements and cattle from 1 piece of land to another. The irrigation also becomes difficult and further lots of fertile land is wasted in

providing the boundaries.

SOLUTION:

Consolidation of the holdings is the best solution which means the reallocation of the holdings is done by creating 1 parcel of land in the place of multiple patches. This plan did not succeed much because of the non uniformity of land in India. Except in Punjab and Haryana where the fertile alluvial tracks are present and in W.B and kerala because of the communist regimes. The other solution is going for cooperative farming where the farmers pool their resources and share their profits. This has also not succeeded except in Maharashtra.

2.SEEDS:

They are the basic agricultural inputs and unfortunately good quality seeds are out of reach for majority of farmers specially the marginal and small farmers because of the exorbitant prices.

Solution: To overcome this the central government has established the national seed corporation in 1963 and in 1969 the SFCI (state farmer's corporation of india) and state seeds corporation were established). There was a major thrust for the production of good quality seeds due to the launching of HYV program i.e., the green revolution in 1966-67.

3. MANURES, FERTILIZERS AND BIO SIDES:

Indian soils are being used for growing arops over thousands of years without replenishment. This caused depletion and exortion of soils resulting in low productivities. The average yields of all the crops are the lowest in the world. The manures and fertilizes play a dominant role however there are practical difficulties in providing the fertilizers and manures because the fertilizers are costly and the cow dung is used as a fuel in rural areas. To put the soil in goon condition, organic manures are essential and the country has a potential of 650 million tones of rural 160 lakh tones of urban compost which is not fully utilized at present. This may solve the twin problem of waste disposal and providing manure to the soil.

Solution: the government is giving high incentives for using the chemical fertilizers. This has enhanced the consumption of fertilizers tremendously.

There are 52 fertilizer-quality control labs in addition to the central fertilizer

quality control and training institute of Faridabad.

The consumption of bio sites in India is rigorously accelerated but this has resulted in the environmental pollution.

4. IRRIGATION:

Although India is the 2nd largest irrigated country after china, only 1/3rd of its cropped area is under irrigation.

Irrigation is the most important agricultural input in the tropical monsoonal country like India where the rainfall is uncertain, unreliable and erratic.

To attain sustainable progress in agriculture, the assured irrigation is a must.

Solution:

The canal maintenance maintaining the lining of canal sides, desiltaion of canals and the reservoirs and construction of the irrigational infracture is being done. (inter-connecting of river waters and canals)

5. LACK OF MECHANISATION:

Most of the agricultural operations in India are carried on by human beings with the help of animal, force, inspite of large scale mechanization in some parts of the country.

This results in huge wastage of human labour, time and results in low percapita yield of the labour force.

There is an urgent need to mechanize the agricultural operations so that the wastage of labour force can be avoided and farming can be made convenient and efficient.

Solution:

The government has come out with subsidized schemes where the farmers are given the tools and implements relatively cheaper.

6. SOIL EROSION:

- large tracks of fertile land suffer from soil erosion, majorly by wind and water.
- these areas are to be properly treated to restore their original fertility.

Solution: soil conservation measures.

7. AGRICULTURAL MARKETING:

The marketing still continues to be in a bad shape.

In most of the villages, the farmers sell their produce to the money lenders which is mostly at unfavourable places and at non-competent prices.

Solution:

The government has come out with the regulated markets. These will generally introduce a system of competitive buying and helps in eradicating the malpractices and ensure the use of standardized weights and measures and machinery for dispute settlements so that the producers receive the remunerative prices without getting exploited by the middle man.

There are more than 2000 principle markets and 4000 sub markets in the country for the benefit of farmer.

8. INADEQUATE STORAGE FACILITIES:

The storage facilities are either totally absent or inadequate in rural areas. Under such conditions the farmers are compelled to sell their produce immediately.

Parsee committee estimated the post harvest losses to be around 9.3% of which 6.6% are due to poor storage facilities.

Solutions:

At present, there are no. of agencies engaged in ware housing and storage activities like FCI, Central Ware-housing Corporation, State Ware-housing Corporation and the grids of rural godown scheme was introduced in 1979-80.

9. INADEQUATE TRANSPORTATION:

This is one of the main handicaps of Indian agriculture.

It lacks cheap and efficient means of transportation. Most of the roads are kachcha and become useless in rainy seasons.

Under these conditions, farmers can’t carry their produce to main market and

are forced to sell their produce in local villages at lower prices.

Solutions:

Several of the government schemes have come for rural connectivity with surfaced roads, FDI also. For eg: pradhana mantri gram sadak yojana

10. SCARCITY OF CAPITAL:

The role of capital input is becoming more and more important with the advancement of farm technology.

The main suppliers of money in the village are the money lenders, the traders and the commission agents, who charge highest interest rates.

Solution:

The central co-operative banks, state co-operative banks, commercial banks, co-operative credit agencies and some non- governmental agencies and organizations are extending the loans to farmers at easy terms.

TYPES OF AGRICULTURE

Agriculture has been the chief occupation in India. Both the physical and human factors have paid their respective roles, which have given rise to different types of farmings in different parts of country.

1. Subsistence farming:

Majority of farmers in our country practice subsistence farming where they cultivate small and scattered holdings with the help of family members & drought animals (ox-used for growth purposes).

The techniques are primitive and the tools are simple because the farmers are too poor.

The productivity is very low due to the lack of electricity, irrigation and the credit facilities.

The main emphasis is on food crops because whatever is produced has to be consumed by family members.

The other crops are also grown like sugar cane, oil seeds, cotton, jute, tobacco etc.,

After independence there is a large scale improvement with consolidations, mechanization increased irrigation and by the availability of credit and electricity. So, presently many parts of country have intensive subsistence farming.

2. Plantation farming:

This type of agriculture involves the growing and processing of ‘ a single cash crop’, purely meant for sale.

The characteristic feature of this agriculture is foreign owner and local labour. This is because it is practiced in vast estates where large capital input is involved with managerial abilities, sophisticated machinery and technical know how with good transportation facilities.

It is practiced mainly in Assam, W.B, nilgiris, annamalai and cardamom hills.

The crops grown are tea, coffee, rubber, coconut, spices, cocoa etc.,

3. Shifting cultivation:

This is very crude and primitive method of cultivation where a section of forest is cleared and the crops are grown after two to three years when the fertility of land decreases, it is abandoned and a new area is cleared. This process continues for 10-15 years and the farmer may return to the 1st piece of land.

This is practiced over an area of 40-50 lakh hectares and every year around 15-20 lakh hectares are cleared for this purpose.

The crops grown are dry paddy, wheat, maize, millets, tobacco, sugar cane etc.,

This practice is causing large scale deforestation and soil erosion, which in turn is causing the devastating floods in the low lying plains.

The tribal people need to be educated about the damage caused by this practice.

AGRICULTURAL REGIONS

Region is an area having homogeneity in relief, soil type, climatic conditions, crops produced, farming practices etc.,

India is a vast country with diverse geographical conditions. So there are

bound to be regional variations in agriculture.

Several scholars have attempted to delineate the agricultural regions of our country. Some of them are:

1. Mr. Torner, 1956

2. M.S.Randhawa, 1958

3. L.D.Stamp,1958

4. R.L.Singh,1971

5. Jasbir singh, 1975

But the scheme suggested by ICAR(Indian council for agricultural research) is simple and comprehencive and accordingly, India is divided into the following 6 types.

1. Rice, jute, tea region:

This region includes the low lands, valleys and the riverine deltas of entire north east, the lower ganga plains, north eastern bihar, terai of UP, east coastal plains and the Malabar plains.

Here, the rain fall varies between 180-250 cms.

Rice is grown in the deltaic alluviums of Brahmaputra, ganga, Mahanadi, Godavari, Krishna and kaveri.

Jute is grown in the hughli basin of W.B and also in terai of U.P, Orissa, Assam, Meghalaya and Tripura.

Tea is grown in assam, Tripura and in W.B's Darjeeling & jalpaiguri.

Other than these major crops, the crops like sugar cane and tobacco that are grown in bihar, coconut and cashew nut along with beetle leaves are grown in coastal areas, pine apple and oranges are grown in N.E.

2. Wheat & sugar cane region:

This region includes Punjab, Haryana, U.P, bihar, western M.P and north eastern Rajasthan.

Most of these areas have rich fertile alluvial soils and some parts have red

soils.

Rainfall is moderate and large parts get rainfall from SW monsoons and some parts get rainfall by western disturbances.

Wheat is grown in Punjab, Haryana and ganga-yamuna doab of UP along with north eastern Rajasthan.

Sugarcane is grown in eastern UP and bihar.

3. Cotton region:

This region spreads on the regur or the black cotton soil areas of deccan plateau where the rainfall varies between 75-100 cms.

Even jowar, bajra and gram are the secondary crops grown here.

In some of the areas where irrigation is available, wheat and sugar cane are also grown.

4. Maize and coarse crop region:

This region includes the western Rajasthan, north western M.P and northern gujrat.

The rainfall is scanty and usually below 50 cms.

Generally the agricultural is possible only with irrigation.

Maize is the dominant crop along with wheat and ragi in mewar or marwar plateau and in the southern parts, rice, cotton, sugar cane along with the pulses are grown.

5. Millets & oil seeds region:

This region includes the areas of poor soils & broken topography of Karnataka plateau, parts of T.N, southern A.P & eastern Kerala.

The rainfall varies from 75-125 cms.

Crops like bajra, ragi, jowar, ground nut, and castor are grown.

The other important fruit crops grown are banana, mango, sweet lime.

6. Fruits & vegetable region:

This region extends from Kashmir valley to Assam in the Himalayas.

Rainfall varies from 60-200 cms.

In the western Himalayas apples, peaches, cherries, plums & apricots are grown.

In the eastern Himalayas, oranges are grown.

Besides these fruits, they also grow rice, maize, potato, chillies & vegetables.

GREEN REVOLUTION

Dr.Norman Ernest Bourlang was the pioneer of green revolution.

He produced dwarf wheat in 1951 because of which Mexico became self-sufficient by 1956.The term Green Revolution was first used by Wilian.S.Gand to describe the emergence & diffusion of new seeds of cereals. The term Green Revolution is used for broad transformation of agricultural sector in the developing countries & to reduce the food shortages by the development of high-yielding variety seeds.

In India, the seeds of Green Revolution were first field tested in1964-65(IR8- the miracle Rice was produced in early 1960's by International Rice Researh Institution, Manila, Phillipines). The high yielding variety programme was introduced in Kharif of 1966 & the production of food grains in 1967-68 was 25% more than the previous year.Intensive Agriculture Development Programme which is popularly known as a Package Programme paved the way for green revolution in India taken up in 1961 to organize India's Agricultural Production with enough resources & to make it effective by diffusing technical know-how, credit & agricultural machinery to stepup the agricultural-production in some selected districts of selected states. It is called the power of green revolution.

COMPONENTS OF GREEN REVOLUTION

There are 13 components & it must be noted that majority of the components don't act in isolation. They are

1). High Yeilding Variety of seeds.

2). Irrigation (surface & underground)

3). Use of fertilizers

4). Use of Insecticides & pesticides

5). Command Area Development

6). Consolidation of land holding

7). Land reforms

8). Supply of Agricultural Credit

9). Rural Electrification

10). Rural roads & marketings

11). Farm Mechanisation

12). Agricultural universities

13). Human Factors

(1) HYV SEEDS: These are the major inputs of agricultural production under green revolution. These have acted as the engines of changes, transforming a traditional farmer into a commercial producer.

They have shorter life-cycle & thereby enable the farmer to go for multiple cropping.

National Seed Corportion established in 1963, which undertakes the production of the Breeder seeds, foundation seeds, certified seeds which are made available to the farmers.

The National Seeds Programme was launched in 1977 which produced several lakh quintals of cerified seeds & were distributed among the farmers of India.

(2). IRRIGATION: Assured supply of water to the crops not only adds the production but also assures the stability in production.

The success of HYV's lies in the availability of water.

Infact, the water is economized because the crops remains in the field for shorter period.

(3) USE OF CHEMICAL FERTILIZERS: The HYVs need heavy dose of irrigation & fertilizers to give high yields. These is no scope of bringing new

area under cultivation & the increase in food grain production can be achieved only by the Trioka i.e., HYV seeds , irrigation & the chemical fertilizers.

NPK ratio should be 4:2:1 but differs quite significantly from place & soil to soil.

The five states (Punjab-190kgs ,Haryana-164kgs, T.N-130kgs, A.P-120kgs, U.P-89kgs per hectare) account for 51.5% of the total fertilizers consumption of the country.

The National Average Consumption was 128.6 kg/hectare during 2009-10 while the rainfed areas are having an average consumption of only 1.5kg/hectare.

The Nitrogenous fertilizers accounts for 60% & Phosphorus accounts for 28% & the Potassium related fertilizers account for 12% of the total share.

India is the third largerst consumer of high quality fertilizers after U.S.A. & China

(4) USE OF INSECTICIDES & PESTICIDES: Green Revolution increased the farm production & also gave birth to the problems of pests, insects and weeds etc., because of the monoculture.

The new seeds are very delicate and highly suspectable to the pests and diseases. Nearly 15-20% of the agricultural production is annually affected by them. The areas with green revolutions are the main consumers of the pesticides. Ex: Punjab, Haryana, TN, UP, AP. UP consumes more than 55% of the country's pesticides. This problem can be solved by producing disease resistant seeds or use of integrated pest management.

(5) Command Area Development (CAD): This is a centrally sponcered scheme launched in January 1975. It is a multi-departmental approach which is to ensure the co-ordination & development of all the sectors in the command area.

The main aim of this scheme is to bridge the gap between the potential created & utilized in selected major & medium irrigation projects for optionising the agricultural productivities.

It covers the following components-

1. On the farm development works

They include the surveying of the soil, shaping of the land, construction of the field channels & the fields drains along with the farm roads.

It also includes the realignment of the field boundaries & the introduction of Warabandi System and supply of all the required inputs.

2. It also recommends the selection & introduction of suitable cropping pattern in a particular area.

3. The development of ground water resources to suppliment the surface waters.

4. Development & maintainence of the main intermediate drainage system.

5. Modernisation, maintainence & efficient operation of the irrigation system.

This programme began with 60 major & medium irrigation projects with a culturable command area of 50million hectares.

Later on, it spread to 193 projects with a culturable command area of 21.44 million hectares. and executed through 54 CAD authorities.

The farmer's participation in the irrigational water management made this programme success because the local farmers will be well versed with the local conditions.

(6) CONSOLIDATION OF LAND HOLDINGS: The holdings in India are small & fragmented because of this a lot of time & labour is wasted. So consolidation is an important solution. This is a failure because of non-uniformity of the land resources present in India.

(7) LAND REFORMS: The land reforms were introduced immediately after independence because the absenee landlordism, tenancy at will & share cropping could not help in inculating interest among the farmers to make investments & to adopt new farm technologies.

The land reforms included

(a) Abolistion of Zamindari system where the tenants become the owners.

(b) Ryotwari system got abolished. This is a system where the peasant is the owner but has to pay a fixed rent to the government.

(c) Mahatwari system got abolished. In this system a choosen peasent(lambardar) was responsible for collecting and depositing the rent to the authorities.

(8) SUPPLY OF AGRICULTURAL CREDIT: Because the HYV's require operational capital for purchase of seeds, fertilizers, pesticides, tractors, harvestors and threshers etc., and a large percentage of Indian farming community consists of small & marginal farmers who do not have their own resources.

Earlier, they used to get the loan from the money lenders but now, the credit agencies like cooperatives, regional rural banks, commercial banks etc., are providing credit.

(9) RURAL ELECTRIFICATION: Its an essential input into the modern agricultural system because many of the activities like lifting of water by tubewells, for sprinkler irrigation and also for processing and preserving the agricultural produce requires uninterrupted suply of electricity at cheaper rates.

Out of the total 6,41,000 number of villages 86.25% are already been electrified and more than 1,40,00,000 energised pump sets are in use.

Haryana was the first state to be completely electrified in 1970.

(10) RURAL ROADS & MARKETINGS: Roads are very essential for connecting the villages with the neighbouring markets.

The cultivation of perishable goods can be done efficiently & profitably if elaborate transport, marketing and storage facilities are available.

The regulated markets will enable the farmer to sell his produce at good renumeration price and the storage facilities can ward off the fluctuations in the market prices and ideally speaking the market place should be with in a distance of 5kms. This will reduce the transportation costs.

(11) FARM MECHANISATION: The success of Green Revolution depends on the farm's mechanization because it helps in judicious ultilization of the inputs like the water, fertilizers, insecticides and the pesticides etc.

It also saves a lot of human labour and quickens the farm operations increasing the farm's efficiency & productivity raising of three or four crops in one year is possible only if the modern technology is made available.

(12) AGRICULTURAL UNIVERSITIES: The agricultural universities and other institutions are primarly engaged in agricultural research & experimentation activities and the findings of the research are passed onto the farmers for the betterment of the agricultural productivities.

(13) HUMAN FACTORS: The man behind the machine is more important because the personal qualities of the farmers, their beliefs, their attitudes and aspirations and education etc., play a major role in their respectivity of innovations and success of certain schemes and they are the major determinants in the success of the green revolution.

DEMERITS OF GREEN REVOLUTION:

(1) Inter crop imbalances increased, only wheat and rice got benefited to some extent.

(2) Inter regional inequalities or disparities increased.

Ex: Within A.P. the deltas got the prosperity & in U.P., the Western U.P. is more prosporous.

(3) Increase in interpersonal inequalities. The green revolution is biased to the large farmers. The large farmers prospered and the small farmers became the agricultural labours.

(4) The unemployment increased due to the increased mechanization.

(5) There is a loss of soil fertility, increasing in the soil salinity is due to the paractices involved in green revolution.

(6) There is a depletion of groundwater resources has taken place in Punjab, Haryana and Western U.P. where the irrigational facilities are not available.

(7) There is a decrease in bio-diversity. Due to the introduction of monoculture the species diversity decreased and due to the reclaimation of forests, swamps and the pasture lands the overall bio-diversity decreased.

(8) The green revolution has increased the pollution levels of soil, water and the food. Many of the foreign chemicals entered into the food chains.

(9) The term Green Revolution is misnomer even if the wild crops are supplied with the same qualities of water and fertilizers, they too can give the same productivities.

Ultimately the agriculture under Green Revolution has not grown at a rate which it was expected.

SUGGESTIONS FOR SUSTAINABILITY OF GREEN REVOLUTION:

(1) Wider areas, the green revolution has affected only 40% of the culturable area. So there is a need for areas covered under green revolution to be increased, which will not only increase the agricultural production but the regional disparities can be removed.

The Green Revolution-II was started in 1985 to cover all the areas specially the dry land or the rainfall regions.

(2) More crops—Wheat to a larger extent & Rice to some extent were benefited by Green Revolution. The other crops like sugarcane, cotton, jute, tea etc., are not effected by it.

The pulses & the oil seeds have suffered at the hands of Geen Revolution.

The GR-II led to Yellow Revolution by taking up the TMOs(Technology Mission On Oilseeds).

Even the horticultural crops for semi arid tracks were introduced and subsequently led to the rainbow revolution.

(3) Irrigation- Inspite of the enhancement of the irrigation facilities after independence, two-third of the total cropped area is still without proper irrigation. If irrigation is extended to these areas they can also have the success of Green Revolution.

(4) Small Farmers- About 85% of the farming community belongs to either small or marginal farmers, who are almost entirely deprived of the benefits of GR and have suffered due to the mechanization.

These farmers should be helped to make the Indian Agriculture a Mass Movement, thereby increasing the productivities.

(5) High Yeilds- Though there has been a tremendous increase in the farm productivities of India, they are still much less with the World’s Best.

(6) Intensity of Cropping (IOC)- This index depends on the extent of area sown more than once and it is the ratio of Gross cropped area to the net sown-area.

IOC= (gross cropped area÷net sown area)×100

Our IOC is 131% i.e., only 31% of the net sown-area is used for more than once (In China, it is more than 90%) So there is much scope for increasing the IOC in India.

The scientific transformation of the cropping patterns & the irrigational system are a must. Otherwise more of the agricultural land may become unproductive in nature.

WHITE REVOLUTION

Milk is primarily obtained buffaloes, cows and to some extent from goat, sheep and camel.

Inspite of our largest cattle wealth, our total milk productivity is miserably low as compared some of the advanced countries.

Because of poor quality of our livestock, milk yield per animal is very low.

It is only 1 litre/ day whereas in Newzealand, Denmark, Holland etc it is 40 litres/day.

In a span of 60 years from about 17 million tones in 1950-51, to 70 million tones in 1996-97 and by 2010 it was 112 million tones. It is a 7 fold increase. At present, we are the largest milk producers in the world.

More than half of the world milk comes from buffaloes, 38% from cows and rest from goats and sheeps, 127.3 million tones for 2012.

More than 66% of the buffalo's milk comes from 5 states- Uttar Pradesh, Punjab, Haryana, Andhra Pradesh and Madhya Pradesh.

The per capita milk production in 1991 was higher in Punjab- 213kgs, Haryana- 173kgs, Rajasthan- 94kgs and Himachal Pradesh- 87kgs.

Operation Flood-1:

It was started in 1970 under National Dairy Development Programme in 10 states (4^{th} five year plan). This also include setting up of 17 feeder dairies, expansion of existing dairies and setting up of 4 mother dairies at Delhi, Bombay, Calcutta and Madras.

Operation Flood- 2: (1980-85)

It aimed at organizing milk marketing in 144 more cities. Proper provision of fodder and feed to the milch animals.

- Controlling of animal diseases.
- Improving the breeds.
- Key village blocks were developed with intensive cattle development project.
- Milkmen were provided with facilities etc.

Operation flood-3: 1985-96

- It aimed at getting up 170 milk centers to benefit 250 districts in 22 states.
- Artificial insemination centers, first aid service centers and also feed distribution centers etc., were set up.
- During the 5^{th} five year plan due to the concerted efforts by both central and state governments there was 4.5% increase in growth rate/year. This revolutionized increase in milk production and has been named as white revolution in 1990s.
- “operation flood can be viewed as a 20 year experiment confirming the rural development vision” – world bank report.
- Operation flood is an integrated dairy development program which has helped 95 lakh farmers farmers through 1,40,227 dairy co-operative societies.
- They procured average of ___lakh kgs of milk/day.
- It has encouraged rural folks to take up dairy as a subsidiary occupation.
- 62% of milk comes up from small and land less farmers.
- The percapita milk availability was 107gm/day in 1969-70 which has increased to 258gm/day in 2009-10. For 2010-11, 281gm/day.
- According to report of national dairy research institute, karnal, India reached a target of 214 gms/day per head in 2000.
- The annual value which India gets from milk production amounts to more than 1745 billions in 2009-10.
- Dairy co-operatives have generated on employment for 14 million farm families.
- About 22.45 million people work in livestock and dairying which is 5.8% of the total work force in India.
- Livestock contributes 22.2% of GDP from agriculture and allied activities.
- As on march, 2010 177 milk unions with operations in 346 districts

covering 1,40,227 village level societies.

AGRICULTURE INFRASTRUCTURE

The infrastruction of agriculture include irrigation, seeds, fertilizers and power.

IRRIGATION:-

Water is an important input for successful agriculture.

DEFINITION:-

The process of supplying water to crops by artificial means such as canals, wells, tube wells, tanks etc. from the sources of water such as rivers, ponds or underground water is called Irrigation.

In India, the average annual availability of H_2O is 1869 billion cubic metre and total utilizing water is 1123 billion cubic mts. [690-surface and 433-underground]

NEED OF IRRIGATION:-

India is an agrarian country where >65% of population depends on agriculture which inturn depends on monsoons.

Unfortunately, monsoons in India are uncertain, unreliable, irregular, seasonal, unevenly distributed.

So, irrigation is indispensible for agricultural development.

Sugarcane, Paddy, Jute, Chillies etc., require more water. So, assured irrigation is must.

It is estimated that the production is 50-100% higher in irrigated lands under similar geographical conditions.

The introduction of High yield varieties has made irrigation to be very important ingredient of agriculture.

TYPES:-

Basically irrigation is of two types:

1) Surface-

A) Canal

B) Tank

2) Underground-

C) Well

D) Tube well

1] A) Canal irrigation:-

This is associated with those areas where perennial rivers flow. Upto 1970s it was very important.They are of two types-

a) Inundation canal

b) Perrennial canal

Canal irrigation is concentrated in two areas.

a) Indo gangetic plain

b) Deltas of south

Even though canal irrigation is responsible for high level of agricultural production for GR, but still it is associated with basic problems like-

1) Water logging.

2) Increase in soil salinity.

3) Breeding mosquitoes.

4) Floods in rainy season.

5) Only suitable for plains.

The percentage of canal irrigated area to the total irrigated area was 39.77% in 1950-1951, decreased to 29% in 2000-2001.

Some of the important canals are present in Punjab, Haryana, Uttar Pradesh, Bihar, Madhya Pradesh, Orissa etc.

In Punjab- Sirhind canal, Bistdoab canal, Bakra canal and upper Bari canal etc.

In Uttar Pradesh- upper and lower Ganga canals, Sharada canal, Agra canal etc.

In Haryana- Jui canal, Western Yamuna canal, Gurgoan canal and Bakra canal.

In Bihar- Son canal, Kosi canal and Gandhak canal.

In Rajasthan- Indira nehar and the Ganga/Bikaner canal.

In Andhra Pradesh- Telugu Ganga canal [started by N.T.R, from Rayalaseema to Chennai], Nagarjuna Sagar's left bank canal is Lal bahadur Shastri canal, Chevella canal, KC, Buckingham canal.

B) Tank irrigation:-

It is the most popular source and important source of irrigation of the Peninsular India.

They may be built by the individuals or by a group of farmers and hence they will be small or big.

The tank irrigation is particularly very well developed in Peninsular India because of

a) The Peninsular India receives less rainfall, hence water storage is a must.

b) Mostly, the rivers get dried in summer that is non-perrennial rivers.

c) The undulating terrain is ideal for natural water storage just by erecting small dams and bunds you can store more water.

d) The presence of hard and impervious rocks does not allow the water to seep into the deeper layers.

e) Because of the hard rocks, it is difficult to dig the wells and tube wells.

Of the total tank irrigation of India, Andhra Pradesh accounts for 28.8% and Tamilnadu accounts for 23% but within the state, Tamilnadu ranks first.

2] C) Well irrigation:-

Well is a hole dug to obtain the sub-soil water. It is the oldest system of irrigation present in India and the world.

The wells are common in areas where the water table is high. Though the well irrigation is ubiquitous but still more concentrated in some areas.

The three important zones where the well irrigation is intensively practiced are-

a) The Indo-Gangetic plains.

b) The Deltas.

c) Foot hills of the Western Ghats.

The well irrigation accounts for 60% of the net irrigated areas.

Inspite the large parts of Peninsular India are not fit due to the rocky terrain and the states of Rajasthan, Gujarat, Punjab and Haryana have brackish water again not fit for agriculture.

D) Tube well:-

Tube well is a deeper well associated with the pumping set run either by the diesel or the electricity.

INTENSITY OF AGRICULTURE:-

It is the percentage of net irrigated area to the net sown area.

The high intensity of irrigation is seen in the hot desert of Rajasthan, the cold desert of Ladakh, Jammu and Kashmir and the Lahul-Spity valley of Himachal Pradesh.

All these areas have 100% irrigation that is if the irrigation is not supplied, they cannot go for the crop production.

More than 80% of irrigation is present in Punjab and Haryana.

More than 60% of irrigation is present in changalpattu of Tamilnadu, Krishna-Godavari delta of Andhra Pradesh, lakimpur of Assam, Birbhum of West Bengal and the Ganga-Yamuna doab of Uttar Pradesh.

The areas of low intensity of irrigation are the areas which do not need irrigation either because of high and dependable rainfall or there are no infrastructural facilities available.

Example- Rajasthan in the west of Aravallis, parts of Bihar, Central

Peninsular plateau, the western coast, Manipur. Mizoram, Tripura and the Andaman and Nicobar islands have 0% of intensity of irrigation.

IRRIGATION POTENTIAL:-

India's ultimate irrigation developmental potential is 139.9 million hectares.

During 1950-1951, it was just 23 million hectares and by 2010 it was 106 million hectares and expected to reach 110 million hectares by the end of 2012.

There is always a gap of 15-20% present between the irrigation potential created and utilised.

By 2017, that is by the end of 12^{th} five year plan, it is targeted to reduce the gap to half of the present.

Irrigation projects are classified into three types based on the acreage of water supply like-

1] Major irrigation projects:-

These are the projects that supplies water to more than 10,000 hectares of land.

2] Medium irrigated projects:-

These projects supply water to 2000-10,000 hectares of land.

3] Minor irrigated projects:-

Which will be supplying water to less than 2000 hectares of land.

Of these three types, the minor irrigation projects are more successful and are catering the needs of large parts of the country.

The working group set up by the government of India identified 583 projects for 12^{th} five year plan.

236 of them are major, 265 are medium, 65 are extensions, renovations, and modernization and 17 special category projects.

PROBLEMS ASSOCIATED:-

1] Improper development of canal network.

2] Indiscriminate utilization of water is increasing the salinity.

3] The methods of water utilization are not proper. [Not using the sprinkler and drip irrigation]

4] The canal maintenance is lacking. [Non-lining of canals]

5] The water storage is causing problems like-

a) Flood proneness.

b) Breeding mosquitoes.

c) Increasing the seismicity.

d) Submergence of the fertile lands.

e) The displacement of the habitations etc.

6] There is under utilization of water potential particularly in the rivers like Brahmaputra, Ganga, Mahanadi and Godavari.

SEEDS:-

They are the basic agricultural inputs to get higher productivities.

But, unfortunately the good quality seeds are out of reach to the majority of the of the farmers specially to the small and marginal farmers because of the exorbitant prices.

The traditional method of seed separation and conservation for the future use is no more practiced.

This situation aroused from the green revolution onwards.

The people are buying the high yield varieties from the markets.

Many a times, the traders and the intermediaries are supplying the seeds of low quality.

These sometimes are unable to bear the flowering and sometimes even the germination of the seed is not taking place itself.

The genetically modified seeds are also flooding the markets and some are

equipped with the termination technology.

Solution:-

To overcome the problems faced by the farmers in procuring the good quality seeds, the central government has established-

1) The National Seeds Corporation in **1963-**

Now it is a limited company put under the Scheduled B Mini Ratnas.

2) The State Farmer Corporation of India in **1969.**

3) The High Yielding Variety Program was started in **1966-1967.**

4) 13 State Seed Corporations were established to supply the improved quality seeds to the farmers.

5) 101 State Seed Testing Laboratories were being set-up.

The NSC undertakes the production of the breeder seeds in its own farms maintained by ICAR and also procures seeds from the certified growers, the agricultural universities and also from the State Seeds Corporation.

The breeder seeds are also called as the Laboratory seeds.

The Foundation Seeds are the second stage of seeds after the breeder seeds in the seed production chain.

These are called as the Field Seeds because these are checked in the fields for their productivities.

Then comes the certified seeds. These are supplied to the farmers through the certified dealers.

The Seeds Act of 1966 was initiated which provides a legislative framework for the regulation of the quality of the seeds.

The National Seeds Project was initiated in 1974 and in 1977, the National Seeds Program was launched in collaboration with the World Bank.

The Central Seed Committee and the Central Seed Certification Board are the apex agencies to the seeds related problems.

The production, the distribution and the utilization of the quality seeds has

been increasing after the green revolution.

Now, the good quality seeds are available in adequate quantities with superior quality at an appropriate time and place with affordable prices.

This ensures the country's food and nutritional security goods.

FERTILIZERS:-

The Indian soils are being used for growing of the agricultural crops for over 1000s of years.

Automatically, this caused the depletion and exhaustion of the soil nutrients resulting in the low productivities.

Hence, the fertilizers play a significant role to improve the soils nutrient base and its productivity.

The 70% growth in the agricultural production is attributed to the application of fertilizers.

Generally, while using the chemical fertilizers the NPK ratio should be 4:2:1.

But it may differ from place to place and soil to soil.

And our usage of NPK is 5.7:2.2:1.

India is the third largest producer and the consumer of fertilizers in the world after U.S.A and China.

The National Average Fertilizer consumption is 128.6kg per hectare. [Punjab-197, Haryana-164, Tamilnadu-130, Andhra Pradesh-120, Uttar pradesh-89kg per hectare]

These five states together consume 51.5% of the total fertilizer consumption of India, while in the rain-fed areas it is very meagre of only 1.5kg per hectare.

The fertilizer consumption was 69,000 tons in 1950-1951, increased to 12.5 million tons in 1990-1991 and at present the fertilizer production in India touched 25 million tons. [50 million tons of urea, 17 million tons of phosphorus and 3 million tons of potassium]

Inspite of our increased productions even now it is difficult to provide

fertilizers to the farmers without subsidies because of their prices.

Solution:-

National Waste Management Council has been set-up to suggest ways and means for utilization of wastes generated in our country.

This has solved the dual problem of the urban waste disposal and providing the organic manure to the soil.

The government is giving high incentives for using the organic manures and subsidies for the chemical fertilizers.

The urea is sold under statutory price control mechanism and the phosphorus and potassium are sold under the concession scheme.

There are 67 quality control labs which have been setup throughout the country to ensure the quality of fertilizers.

In addition, a Central Fertilizers and Quality Control Training Institute was setup in Faridabad with three regional centres at Mumbai, Chennai and Kolkata.

The quality fertilizers are supplied to the recognized dealers to fill up the demand and supply gap, the government is importing fertilizers from South American and CIS countries.

This includes the broken up countries of U.S.S.R.

The government is also encouraging the setting up of New Naphtha and Natural Gas Based Fertilizer Plants.

INMD, the Integrated Nutrient Management Division was setup to ensure adequate availability of quality fertilizers through periodical demand assessment and timely supply.

The government is also promoting the Integrated Nutrient Management.

This is based on the laboratory testing of soils where there will be suggesting the judicious and balanced use of chemical fertilizers along with the organic manure and the bio-fertilizer. They are also promoting the organic farming.

This is being encouraged to get good productivity and to conserve the fertility and natural balance of the soil.

POWER:-

The power is of two types:

1) The manual power-

This is the physical labour of the human along with the animal force.

2) The mechanical and the electrical power-

This is with the use of the tractors, tillers, harvesters, and the other agricultural machineries.

The electrical power has become one of the major inputs into our agriculture specially after the green revolution.

Prior to it, much of the agricultural work like supplying of irrigation water, ploughing of fields, the transportation of the produce etc., was done manually with the help of animals.

The electricity is the chief source of energy which is used for drawing water from the wells, tube wells, etc., processing and preserving the agriculture produce and also for the judicious utilization of water resource in the form of drip and sprinkler irrigation.

The share of mechanical and electrical power has increased to more than 85% of the agricultural operations increasing the overall productivities.

Realizing the importance of electricity for the growth and development of agriculture, the rural electrification programme was taken up immediately after independence.

At that time, only 1300 villages had electricity with 6400 energized pump sets in the entire country.

But the recent statistics shows that 86.25% of the total villages [6,41,000] got the electricity and are having more than 1.4 cr of energized pump sets.

Haryana was the first state to have complete electrification of its total 6759 villages in 1970.

Punjab, Kerala, Andhra Pradesh, Karnataka, Gujarat, Himachal Pradesh, Tamilnadu, Jammu and Kashmir, Maharashtra and Nagaland are having nearly 100% electrified villages.

Government has initiated strategies and programmes which have been directed towards the replacement of traditional and inefficient implements by the improvements.

The Farm Machinery Training and Testing Institutes have been established.

New components were being approved in the Tenth Five-year plan for promoting and strengthening of agricultural mechanization through training, testing and demonstrating programmes are being continued.

The farm machinery is also made available to the farmers through subsidies on loan basis. This is to increase the agricultural productivities.

INSTITUTIONAL FACTORS:

They include the factors related to the land, its capability and its productivity and these factors are put under different heading like

1. Land holding
2. Land tenancy or tenure
3. Land reforms
4. Cropping pattern
5. Agricultural productivity
6. Agricultural intensity
7. Crop combinations

LAND HOLDINGS:

The seemingly abundance of net sown area of 142.1 million hectares and the total cropped area of 189.7 m.h. is a sort of myth because it pales into insignificance due to the division of area into economically non-viable small and scaterred holdings.

The land use patterns and yields per unit area depend on the size of the land holdings. The division of land holdings is socially justifiable but economically not viable.

LAND TENURE:

This includes all forms of tenancies and also ownerships in all or any form. This affects the agricultural operations and cropping patterns in many ways. At the same time of independence there were two main tenural systems present in india like zamindari and the ryotwari. These two determined the relations between the land on one hand and on the other hand, the interested

parties like the government, owner, and the cultivator.

The zamindari system is a system of absentee landlordism where the real tillers or the cultivators were exploited, neither the owner nor the cultivator was willing to develop the land. So there was no improvement in the land or the techniques of cultivation. Hence no increase in productivity.

In ryotwari the owner is the tiller but can go for development of the land based on his socio-economic conditions. Many of our farmers are poor and their socio-economic conditions were very bad. Hence no development of the land or productivity.

TENANT-CULTIVATOR SYSTEM:

This system faces major disincentives like the fear of eviction, insecurity of tenure and high rents, etc.

BATAI TENURAL SYSTEM:

This gives protection to the cultivator because it involves purely crop-sharing. There is no fixed rent but they share the crop according to the contract of 50-50 basis. This system is much better than the fixed caste tenancy, where if the crop fails, the cultivator falls into the debt trap and the money lenders make merry.

SOLUTIONS:

Security of tenure

Land ceiling act

Rationing of the land to poor reforms

Land reforms, etc.

have given the security and confidence to the cultivators. Thereby, india has seen an increase in the agricultural productivities. (the reforms could not take place because the rich farmers were the politicians who were the back-bone of the reforms)

LAND REFORMS:

It is one of the important legislation in the institutional factors, for improving the agricultural situations within the country, because the absentee landlordism, tenancy at will, share cropping etc were not inculcating interest

among the farmers for agricultural development. So, the zamindari, ryotwari and mahalwari systems were abolished.

This also included-

Abolishing of the intermediaries

Introduction of the tenancy legislations

Consolidation of the land holdings

Land ceilings acts, etc. (5 member family was taken as a basic unit for ceiling activities. The area under plantational crops, the land used for commercial activities and for industrial activities were exempted from ceilings)

These reforms resulted in acquiring of the excess land by the government agencies or the revenue authorities and was redistributed among the poor land less farmers.

THE DEFECTS:

1. The government compensated the lambardaar's who became the rich land lords.

2. The tenancy legislation include the fixed tenure and the fair rent, these two were failed because of the internal agreements between the tiller and the owner, or because of the socio-cultural milieu of that region.

3. The consolidation of the land could not take place in india because there was no uniformity with respect to the land.

4. The binami names or impersonations has taken its own stroll.

So, this lead to very small surplus land identification. Much was distributed to the persons who already had it. Some of them got badlands which were non cultivable. The distributed land was acquired by the same person who lost it to the government by giving less prices to the farmers. On the whole, this legislation has restricted the rural base with equitable tenural system and paved the way for green revolution.

THE CROPPING PATTERN:-

It means the proportion of area under various crops at a point of time. This is a dynamic concept. It changes over space and time .The cropping pattern of a region is closely influenced by the geo-climatic, socio-cultural, economic,

historic and political factors etc., In some parts, even the physical environment reduces the choice of crops, either by prohibiting the growth of certain plants or by reducing their yield per unit area.

Man, by his technological advancement ,can ameliorate the physical limits like which have been done in Punjab, Haryana, rajasthan, etc., In the areas where physical diversities are less, the cropping pattern are less diversified.

Example: In rajasthan, there is the deficiency of rainfall, hence only BAJRA is grown. In Brahmaputra valley, only RICE is grown. In the black soils of Gujarat and maharastra, only COTTON is grown. In the loamy soils of Punjab, Haryana and Western U.P, only Wheat and Rice are grown.

The cropping patterns will be varying from region to region depending upon the terrain, topography, slope, temperature, the amount & reliability of rf, the availability of water and soiletc., Moreover, the land tenancy, ownership and size of the holdings also imposed restrictions on the cropping pattern.

The cropping pattern of an area is determined on the basis of the areal strength of an individual crop called as the dominant crop and the minor crops are eliminated.

Apart from the proportion of an area under a particular crop, its relative yield also guides to the suitability of that crop in a given geo-climatic and cultural setting. There are two indices used for the determination of suitability of the crops in that region, like,

THE RELATIVE SPREAD INDEX:

It is the area of the crop expressed as the percentage of the total cultivated area and is given as,

Relative spread =(area of particular crop ÷ entire region) X100

THE RELATIVE YIELD INDEX:

This is the mean yield of the crop and expressed as,

RY= (mean yield of the crop in a component areal unit ÷ mean yield of the total area) X 100.

If the relative yield of a crop is less than 90%, the crop should not be grown in that region. hence, an alternative, more efficient new cropping patterns may

emerge in that region. The change of cropping patterns and the introduction of the crops which enhance the soil fertility and make agriculture more remunerative and sustainable, are a must.

AGRICULTURAL PRODUCTIVITY:

It is an input-output ratio and is the measurement of the production and the inputs required for that production is known as agricultural productivity. Traditionally, this measurement used to take into accounts the inputs like labour and capital as the costs incurred in the production of agricultural productivities. At present, the question of the sustainability of the soil, the ecosystem and the social acceptability have become more increasingly important.

The productivity of a region is an interplay between a number of physical (socio-economic and institutional factors) and cultural factors. It also depends on the attitudes of the farmers towards the work and their aspirations for a better standard of living. The measurement of agricultural productivity helps us to know the performance of an area compared to that of neighborhood areas, which can be helpful to ascertain the ground realities and the cause of agricultural backwardness of that area. Thereby, to implement better plans to minimize the regional inequalities. Some of the methods or the techniques used for the measurement of agricultural productivity are,

1. Input-output ratio, given by KUSRO in 1964

2. Ranking co-efficient method, given by KENDELL in 1939, STAMP in 1960 and SHAFI in 1990.

3. The net income in rupees per hectare, given by JASBEER SINGH in 1985.

Many more techniques are present but all of them suffer from certain drawbacks because their results are satisfactory at the micro-levels, but are failing at the national or global levels.

THE RANK CO-EFFICIENT METHOD:-

This was applied to determine the agricultural productivity of India by taking the statistics from the years 1990-1995 and an index has been prepared and the areas of different agricultural productivities have been delineated.

Eg :- Suppose, in a region there are 80 component areal units present and in a particular component areal unit ,wheat ranks 5^{th} ,rice ranks 12^{th} ,grams 20^{th}

,cotton 21st ,barley 34th ,sugarcane 38th ,pulses 40th and oil seeds 54th. These are the ranks of particular crops on the basis of their average yields. Then RC would be the summation of all the ranks and its average.

RC = (5+12+20+21+34+38+40+54)/8 =28

The component areal unit with relatively high yields will have low RC [Ranking Co-efficient] and vice-versa. The areas delineated according to their productivities in India fall under the following 5 categories:-

Very high productivity areas:- These are the areas where the RC is less than 75 and the farmers of these areas are highly receptive, to the new agricultural innovations. These areas include Sutlej-Ganga plains , Brahmaputra valley ,Valley of Kashmir ,Coastal odisha , AP ,Tamil Nadu and Kerala and the districts of Kolhapur and Sangli of MH. The farmers of these areas are highly receptive to the new agricultural innovations.

High productive areas:- RC is less than 90.These are the areas around the vicinity of very high productivity areas.

Medium agricultural productivity areas:- RC is less than 105. This covers the isolated tracts of UP ,Bihar, M.P, Gujarat, Odisha and Tamil Nadu, where highly diversified crops are grown ranging from paddy to the millets.

Low agricultural productivity areas:- RC is less than 125. This includes greater parts of the peninsular India.

Very low productivity areas: RC is more than 125. These areas include greater parts of the peninsular India, Chota Nagpur Plateau of Barmer and Jaisalmer of Rajasthan, Udhampur and Doda of Jammu and Kashmir, Bhavnagar, Surendranagar , Ahemadabad and Sabarkanta of Gujarat.

The differences given between the various ranks among different parts are not maintained and are not uniform.

JASBEER SINGH'S YIELD PER ACRE CRITERIA:- He assessed the net income in rupees per hectare of the cropped area and divided the areas into 5 productive zones in terms of money during the period of 1991-1994.

1) Very high productive areas:- They are the high productivity areas where the income generated is more than 15,000/- per acre.

2) High productivity areas:- where the income is more than 12,000/- per acre.

3) Medium productivity areas:- where the income is more than 9000/- per acre.

4) Low productivity areas:- income, more than 5000/- per acre

5) Very low productivity areas:- income less than 5000/-per acre

Jasbeer singh said that these are the nominal rates of income only pertaining to the period between 1991-1994. But, as the technology increases and the agricultural infrastructures are made available, the productivities of different areas will be changing accordingly.

All these methods help us to know the real causes of the backwardness. Thereby, we can introduce the pre-requisite techniques for future planning and development and lessen the regional inequalities and make the agriculture more sustainable along with rural progress.

CROP COMBINATIONS

It is an integrated assemblage of various crops grown in an areal unit. This constitutes an important aspect of agriculture which provides a good basis for agricultural regionalization. For comprehensive and clean understanding of the agricultural region and for the development and planning of that region, a systematic study of crop-combination is of great importance. This is a dynamic concept and may change with the government policies or with the supply of irrigational facilities.

Different methods are applied in the delineation of crop combination regions like,

Arbitrary choice method:-In this method, only the first crop or the first two crops or the first 3 crops, etc., are considered. Here, they are irrationally excluding the rest of the crops grown which are even adding weightage of % age in the total cropped area.

Statistical approach method:- In this method, some of the quantitative techniques are applied for the arbitrary choice methods like ,

The standard deviation method:- Given by weaver in 1994. He based his analysis on the acreage statistics i.e., by the % of the total harvested land occupied by each crop. Even the crop with 1% of the cultivated area was taken into consideration. The formula he used was, $Sd = \sum d^2/n$

d =difference between the actual crop %s.

n =no.of crops grown in a given combination.

By this method we can identify the total harvested crop land by each crop.

Example: in mono culture, 100% of the total harvested crop land is of a single crop. 50% each for a two crop combination, 33.3% each for a three crop combination and so on.

Maximum positive deviation method:-This was given by Rafiulla in 1956. This statistical technique advocated by him is more accurate and scientific. The formula he used was, $d = \sum(D^2p - D^2n)/N^2$

d =deviation

Dp =positive difference from mean value

Dn =negative of crops from mean value

N =number of crops in combination

Some crop combination regions identified in India according to this method are,

Andhra Pradesh coastal-rice, sugarcane

Rayalaseema-rice, oil seeds

Telengana-rice, coarse cereals

West Bengal-jute, rice

Western U.P-wheat, sugarcane

Eastern U.P+ northern bihar-rice, wheat

Punjab and Haryana-wheat, rice or cotton

West rajasthan-wheat, bajra (Indira Gandhi canal)

Gujarat-oil seeds, wheat or rice

North Maharashtra-cotton, wheat

East and south Maharashtra-jowar, wheat

North Tamil Nadu-rice, sugarcane

Central Tamil Nadu-cotton or ragi, rice

Kerala-rice, coarse cereals or sugarcane

Western Ghats and hills of Assam and Darjeeling- tea, plantation crops.

Similarity in agro-climatic regions have same crop combinations. It is a very important tool in the hands of the agriculturalists for solving many problems with the same aspects.

LAND CAPABILITY

This looks into the information regarding the soil potentialities of different areas, i.e., it looks into the properties of the soil that determine the ability of its own to produce crops on a virtually permanent basis. This is a scientific appraisal of the physical characteristics related to the land and its inherent soil qualities. This is by taking into consideration of the texture of the soil, aspect of the slope, the terrain temperature, rainfall, the run-off and the water availability. By this scientific appraisal, we can delineate or differentiate the problematic and the potential aerable lands which is helpful for planning efficiently the specific cropping patterns with their input requirements under different conditions.

We can assess the land's response to the use of different bio-chemical techniques. This can be used for changing the cropping pattern, farm technology and the adaptability of the crops to the new environment. The land capability is usually represented carto graphically. The All India Soil and Land Use Survey Organisation (AISLSO), a body of ICAR, which has identified 8 different land use capability classes in India. The first 4 classes of land are suitable for cultivation and the next 4 are non-suitable.

CLASS-1: This consists of very good cultivable land (the transported soils)

CLASS-2: They are good cultivable lands but needs some protection.

CLASS-3: Moderately good cultivable lands but special attention has to be paid.

CLASS-4: They are the fairly good lands suitable for limited cultivation and needs intensive treatment to control the erosion and to overcome the soil limitations.

CLASS-5: These are suitable only for grazing and needs protection from gullying.

CLASS-6: These are the lands which are well suitable for grazing or forestry.

CLASS-7: They are fairly suitable for grazing and more suitable for forestry.

CLASS-8: These lands are suitable only for wild life recreational activities and to protect the water facilities.

AGRO_CLIMATIC REGIONS OR ZONES:

India is a country of great physical diversity with variations in terrain, temperature rainfall, soils and geology. All the above have closely influenced the cropping patterns and other agricultural activities. The planning commission and the national remote sensing agency divided the country into 15 agro-climatic zones in 1979 through the national agricultural research project of ICAR. This zoning is done by taking into account, the physical attributes of the land and socio-economic characteristics of the region. They include,

The N-W mountainous region (J &K, HP, N.UP(uttarakhand)

N-E region including all the 7 sisterly states of N-E.

Sutlej-yamuna plain includes Punjab, Haryana, parts of UP.

Upper ganga plains, parts of western and central UP.

Middle Ganga plain (eastern UP, northern bihar)

Lower ganga plain (W.Bengal)

S-E plateau region includes chattisghar, parts of UP, Orissa, W.bengal, southern bihar (jharkhand and eastern MP)

The aravalli-malwa upland (E.rajasthan and the N.W MP including the Chambal valley)

Plateau of maharastra. It also includes the southern MP region

Deccan interior (parts of Karnataka, T.N, A.P, kerala)

Eastern coastal region. It includes coastal plains from the south of

Subarnarekha river till kanyakumari.

Western coastal regions. It includes the western sides of W.ghats from the konkan to the Malabar plains (below the khandesh plains to kanyakumari)

Gujarat region. Entire Gujarat

Western rajsthan: parts of rajasthan to the west of aravallis.

Islands of Andaman and nicobar.

ECOLOGICAL PROBLEM OF GREEN REVOLUTION:

Through the introduction of HYVs have undoubtedly stimulated the agricultural development in India, making India a self-sufficient and self-reliant country. Related to the agriculture, it has also given rise to numerous ecological problems like,

GLOBAL WARMING: The depletion of the forests and the reclamation of the forest land for the agricultural operations caused the accumulation of the CO2 in the atmosphere. The forests were acting as the CO2 sinks. The CO2 is a green house gas; the more its concentration, the more will be global warming.

PASTURE LANDS: Inspite of our largest cattle wealth in the world, we had only 4% of the pasture lands, but that too were reclaimed for agricultural activities under GR.

SALINISATION: Because of the increased use of chemical fertilizers and intensive canal irrigation, the soil has become non-productive due to the increase of salinisation. The organic manures which were used prior are not available now –a-days, to be used in the agricultural operations.

SOIL EROSION: Because a single crop is used, year after year and season after season without any crop rotations, causing the imbalances in soil mineral content and the soils are becoming easily exhausted.

WATER LOGGING: This condition is again degrading the soil because it is turning out to be marshy in nature and also, this is acting as the breeding ground for the mosquitoes, increasing the malarial incidents.

WATER TABLE: The ground water table is getting lowered and lowered in PUNJAB, HARYANA and RAJASTHAN. These are the states which receive around 60cms of rainfall, but the exploitation of ground water is much more than the replenishment. The farmers are bordering the lands with eucalyptus

and poplar trees which are also causing the drain of ground water (the evapo-transpiration from these trees is very high).

POLLUTION: The pollution levels of soil, air, water, and noise are increasing tremendously due to the use of chemical fertilizers and mechanization of agriculture.

BIODIVERSITY: There is the reduction of bio-diversity due to the reclamation of the forest lands, pastures and swamps.

SOIL FERTILITY: There is a decline in the soil fertility and the soil is getting degraded due to the single crop grown season after season.

SILTING: The silting of rivers and canals is taking plaace due to the intensive agricultural operations which decreases the carrying capacity of the rivers and canals, and the storage capacities of the tanks, dams and reservoirs.

DISEASES: Because of contamination of food, milk, and water, several diseases are emerging, causing health hazards like cancer, bronchitis, eye infection, etc

EUTROPHICATION: The increased use of fertilizers is enriching the mineral content of the nearby lakes, causing increased growth rates of the aquatic weeds. This is creating the deficiency of Biological Oxygen Demand (BOD)(aquatic life is disappearing)

SOLUTIONS:

1. Biological control of predators and parasites has to be done without using the chemical insecticides and pesticides. This includes the biological control by genetic method, where the males are sterilized to check the growth and explosion, but it requires continuous monitoring and research.

2. Biological control by harmonal methods: In this, the crop ecosystems are modified to the detriment of the pests or to the advantages of their natural enemies.

3. The plantation dates have to be modifies to check the life cycle of the pests and insects.

4. The crop rotation has to be implemented, which not only replenishes the mineral content of the soil but also does not allow the completion of insect life cycle.

5. The use of chemical fertilizers has to be reduced and maximum of the organic manure should be used as the fertilizers.

THE MINERAL RESOURCES

We get minerals in two forms. If it is in the pure form, we call it as a mine and if it is in the impure , we call it an ore.

Occurrence of minerals

We find minerals in different places, different depths and different forms. They will be as follows

1) Veins:
   Most of the minerals will be present in the cracks and crevices of the earth's crust. Generally the pure minerals are found in them. This is because different minerals will be having differential melting and boiling points. For example: Tin, Copper, Gold, Lead and Zinc. If the cracks are wider they are called as the loads.
2) Beads and Seams:
   Most of the minerals will be present in the form of sedimentary accumulations which will be layered in structure in the form of beds and seams. For example: Coal, Marble and Common salt.
3) Weathered products:
   Some of the minerals are also present in the form of the weathered products due to the extensive leaching. For Example: Bauxite, hematite, manganese, Nickel ores etc.,
4) Alluvial or placer deposits:
   Many of the minerals will be eroded by the water action and will be deposited along with the alluvial soils may be in the form of riverine alluvium or the coastal alluvium.
   Ex: Gold, Tin, Platinum, Tungsten, Diamonds etc.,

METHODS OF MINING

There are 3 different methods used for the extraction of minerals from the mines depending on the places of their occurrence.

1) Open caste mining: - This is very easy, simple and cheap mining for the extraction of minerals which are present nearer to the crustal surfaces.
2) Underground mining: - This is the method employed for the

extraction of the deep seated minerals. This is very costly and dangerous type of mining where lot of technology is used. They will be constructing the vertical and the horizontal shafts and using the conveyer belts to get out on to the ground surfaces. This mining many a times cost the lives, because there may be the roof collapsing and the emission of the poisonous gases take place.

3) Alluvial mining or panning: - Here the hydraulic pressure along with multiple sieves are used for the mineral extraction.

Mineral resources:

1. Metallic minerals:
   a. Ferrous: Fe, Mn, Si, Cr etc.,
   b. Non-ferrous: Cu, Pb, Zn, Ag, Au etc.,
2. Non-metallic minerals:
   Lime stone, dolomite, barite, asbestos, mica, chinaclay, gypsum etc.,
3. Refractory minerals:
   Magnetite, kyanite, siliminite, graphite, fire clay etc.,
4. Mineral fuels:
   a. Fossil: Coal, oil, natural gas etc.,
   b. Nuclear: Uranium, thorium, zirconium, petite etc.,

THE ENERGY RESOURCES

The wheels of progress move with the flow of energy. If the so called democratically elected governments provide affordable and renewable energy services in sufficient quantities, automatically the living standards of the population increases, increasing the economic prosperity f the country.

It is the primary input in the production of goods and services. The role of energy has been significantly increasing with the increase in the industrialisation and urbanisation (it has become a key role player). Previously the energy was confined to the kitchen as a fuel for household cooking but now it is associated with a wide range of utilities. 90% of the rural Indian's energy comes from the non-commercial energy resources. The non-conventional energy resources in India are in the form of technology demonstrators and the pilot projects. Depending on the source and utilisation the energy can be divided into commercial and non- commercial.

1. Commercial:
   a. Conventional :
      i. Fossil: coal, oil, natural gas

ii. Nuclear: thorium, uranium, zirconium
iii. Hydel

b. Non-conventional: wave, tidal, solar, OTEC, biogas, biomass etc.,

2. Non-commercial or traditional: fuel wood, dung etc.,

CONVECTIONAL ENERGY RESOURCES

COAL: It is an inflammable organic substance composed mainly of the hydrocarbon and volatile matter, moisture, ash, etc., in varying proportions. The coal is concentrated in the sedimentary rocks generally along the river valleys. It is often called as the “black gold’’. The recent estimated reserves of coal in India are around 280 billion tonnes up to a depth of 1200meters. 94% of the total coal generated is consumed by the power and the industrial sectors. In India, we have a coal mining history of more than 225 years. The percentage of carbon content in coal depends upon the duration and the intensity of heat and pressure on the vegetative matter or wood. Depending on the percentage of the carbon content, 4 varieties of coal are recognised like anthracite, bithuminous, lignite and peat.

1) Anthracite: This is the best quality coal where the carbon content is less than 80%. It is very hard, compact and jet black coal having semi metallic lustre. It ignites slowly and burns with short blue flame. It is an indication of highest heating value or the calorific value. It is found in Jammu and Kashmir and that too in small quantities.
2) Bituminous: This is the most widely used coal having 60-80% of carbon content. It is dense, compact but brittle in nature. It does not have any traces of original vegetative matter from which it is formed. It is used in heating purposes and also for the production of coke and gas. It is found in Jharkhand, Orissa, MP, WB and Chhattisgarh.
3) Lignite: It is known as brown coal. A lower grade coal with around 60% of carbon. It represents the intermediate stage in the alteration of woody matter into coal. It is found in Rajasthan, Assam, TN, and Jammu and Kashmir.
4) Peat: it is the 1st stage of transformation of wood into coal and contains only 50-60% carbon. It burns like wood with less heat, more smoke and lot of ash. It can become a food fuel only if compressed into the bricks.

Occurrence of coal

The coal baring strata of India are gnomically classified into two

main categories

1) The gondwana rocks with gondwana coal fields.
2) The tertiary rocks with the tertiary coal fields.

GONDWANA COAL:

This coal is about 250 million years old and accounts for 98% of the total reserves of India and 99% of the total coal production. The lower Gondwana rocks in which the coal occur are called as the Damuda series of rocks. The Gondwana coal generally occurs in the river valleys and basins like that of the river Damodar in Jharkhand and WB, river Mahanadi in Chhattisgarh and Orissa, river son in Chhattisgarh and Jharkhand, river Godavari and Wardha of MH and AP, river Narmada of MP and Gujarat. The volatile compounds and the ash contents are very high among the Gondwana coal but it is free from moisture.

TERTIARY COAL:

The tertiary rock system bears coals of younger age and the age is of only 15-60 million years old. It is confined mainly to extra peninsular region and this coal consists of low carbon content with high percentage of moisture and sulphur. This coal occurs in the parts of Assam, Meghalaya, Arunanchal Pradesh, Nagaland and in the Himalayan foot hills of Darjeeling along with TN, Kerala, Rajasthan, Uttarakhand and Tamil Nadu. The tertiary coal generally includes the lignite and peat. 91% of the total lignite is concentrated in TN at Neiveli lignite fields of south Arcot, Vallalor district. These are the largest deposits of lignite present in south-east and south Asia.

The peat is confined to few areas only. In the Nilgiris at an elevation over 800meters and in the Kashmir valley, it occurs in the alluvium of Jhelum. In WB, the peat beds are noted at a depth ranging from 2-11meters that too only around the Kolkata and the suburbs.

PROBLEMS OF COAL MINING IN INDIA

1) High costs: The distribution of coal is uneven. The northern plains and the western parts are deprived of coal but there are several industries present. Hence the transportation costs are very high causing the higher costs of coal.
2) Low heating value: The Indian coal has high content of ash. Hence, the low calorific value thereby reducing the energy output and creating the problems of ash disposals.

3) Low productivity: Because of the underground mines, the productivity of labour and machinery is very low i.e., the OMS (output/man/shift) is very low. Around 80% of the manpower accounts for only 30% of the total output.
4) Heavy losses: There are heavy losses due to the fires in the mines and pit heads, because our coal has less moisture and high volatile components.

Conservation:

1. The misuse of good quality coal should be stopped.
2. Unsystematic methods of extraction should be abandoned.
3. The coking coal should be used only for metallurgical industries.
4. Blending of low grade coal with the superior quality in requisite proportions should be done for the best calorific value.
5. Selective mining should be discouraged.

Vision coal-2025:

It wants to enhance the coal production by over 1000 million tons per annum which requires 28-30 billion US$.

The demand for power generation will have a short fall of 100 million tons by 2015. The coal reserves in India are expected to be around 580 billion tons which will be 7.09% of the world's total reserves. India will be the 5^{th} largest country after US, Russia, china, Australia. The production of coal touched a mark of 570 million tons during 2010-2011.

Petroleum or mineral oil:

The word is derived from two of the Latin words 'Petra' means rock and "oleum''means oil. Thus, the petroleum is the oil obtained from the rocks particularly from the sedimentary rocks. It is an inflammable liquid with 90-95% hydrocarbons and the remaining are chiefly the organic compounds containing oxygen, nitrogen, sulphur and traces of organometallic compounds along with certain paraffins, unsaturated hydro carbons and small portion of the benzene groups.

Petrol & its products:

They are mainly used in the motive power and has revolutionised the transportation sector of land, water and air. It emits very little smoke and no

ash. It is 30% less pollutant than the coal. It is called as the liquid gold.

Occurrence:

Petrol has an organic origin and it is found in the sedimentary basins and the shallow depressions of the Mesozoic of the tertiary times. The oil reserves are always associated with the anticlines and fault traps. The decomposition of the organic matter from both the plants and animals under temperature and pressure led to the formation of oil.

An oil reservoir must have 3 prerequisite conditions:

1. Porosity: Porosity, so as to accommodate sufficiently large amounts of oil.
2. Permeability: Permeability, so as to discharge the oil when an oil well is drilled.
3. Impervious beds: The porous sand beds, sand stone, conglomerates of fissured lime stones etc., containing the oil should be capped by impervious beds. This is to contain the oil seepage by percolation into the surrounding rocks.

Reserves:

Although India has vast areas covered by sedimentary rocks, oil is found only in limited situations. 14.1 lakh sq.km are about 42% of the total area is covered with the sedimentary rocks. The offshore areas of Mesozoic and tertiary time rocks constitute about 2.5 lakh sq.km up to a depth of 100m and 0.7 lakh sq.km up to a depth of 200m.

Thus the probable oil bearing rocks constitute about2.3lakh sq km. The estimated petrol reserve is 1201million metric tonnes from all sources that is from both the onshore and offshore ares of India.

The major oil producing areas are

1. North-East India.
2. Western India.
3. South-east India.
1. North-East India:- the major fields in this region are those of assom and neighbouring areas ie., the six sisters concerned areas.
   ASSAM:- It is the oldest oil producing state in India and the oil fields are present in
   1. Digboi

2. Nahorkatiya
3. Moranhugrijan
4. Rudrasagar
5. Sibsagar
6. Lakawa
7. Galeki
8. Badarpur
9. Anguri
10. Barholla

Refineries are present at Digboi, Gauhati, Bongaigaon and Nomaligarh.

ARUNACHAL PRADESH:-The reserves are present at Monabham, Kharsang, Charaji etc.,

TRIPURA:-Manamunbhanga, Baramura, Subhang, Mane, Ampibazaar, Dambura and Amarpur.

2. Western India:-

OIL FIELDS:- Gujarat- The fields in Gujarat are present around the gulf of combat. The main belt extends from Surat to Amreli. The main oil producing districts are Kutch, Vadodara, Baruch, Surat, Ahmedabad etc., The ankaleshwar oil field is called as the fountain of prosperity. There are 3 crude rich regions present in Gujarat.

a. Kambat or Lunej field
b. Ahmedabad field
c. Kalol field

RAJASTAN:-Tanot-jaisalmer basin is the upcoming basin having good oil reserves

3. South-East India:- The KG basin of the Andhra Pradesh is the most important

   OFF-SHORE OIL FIELDS

   Aliabet, Bassein and Mumbai high are the areas in the gulf of combat field region. Mumbai high alone produces around 70% of the total crude production of India. Extensive surveys have been conducted by ONGC in many parts of the country of which some of the other fields which are promising where we can go for commercial exploration in the near future are

   a. HP:- In HP, Jwalamukhi, Nurpur, Dharamshala and Bilaspur are

quite important.

b. J&k:- Musalgarh
c. Punjab:- Dasuva etc.,

Oil refineries:- The oil taken out of the oil wells is in its crude form which has to be refined. During the process of refining we obtain Kerosene, Diesel, Petrol, Bitumen, Parafin, Lubricants, Tar etc.,

There are 21* refineries present of which 17 are in public sector, 3 in private sector, 1 in joint sector. They are :

Group A:- Indian oil corporation run refineries are present at

1. Digboi
2. Gauhati
3. Barauni
4. Koyali
5. Haldia
6. Mathura
7. Panipat
8. Bongaigaon

Group B:- BPCL run refineries

9. Mumbai
10. Kochi

Group C:- HPCL (hindustan petrol corporation limited)

11. Vizag
12. Mumbai

Group D:- Chennai petrol corporation limited

13. Manali
14. Nagapattanam

Individual :

15. Nomaligarh refineries limited, Assam
16. Tatipaka refineries, ONGC, Andhra Pradesh
17. Mangaluru refineries private limited

Private sector

18. Reliance petroleum limited, Jamnagar
19. Reliance petrol chemicals limited, SEZ of Jamnagar
20. ESSAR petro chemicals limited, Vadinar, Gujarat

Joint sector:-

21. BEENA of M.P between BPCL and Omen petroleum limited

The oil accounts for about 34% of the total energy consumption and the transportation sector accounts for 50% of the total oil consumption followed by the industries about 20%. The Indian govt maintain a strategic petroleum reserve equal to 5 million metric tonnes for unforeseen difficulties. They are maintained at Vizag-1 MMT, Mangaluru-1.5 MMT, Padur-2.5 MMT .

The govt has officially ended the administered pricing mechanism of petrol and petroleum products in April 2002.

The crude oil production during 2010 and 2011 is 37.71 MMT which is an increase of 11.9% than the 2009 and 2010 productions(onshore accounted for 16.426 MMT and offshore accounted for 21.284 MMT)

The consumption of petroleum products during 2010 to 2011 was around 190.362MMTs.if the current rate of consumption goes on,our reserves will last only for 30yrs.

ONGC VIDESH LIMITED(OVL):- This is the face of India's oil company to the world.OVL is involved in 15 countries with 40 projects in hard and the investments made are aroud 50,000 crores.the associated companies like OIL, IOC, HPCL, BPRL, GAIL etc are involved in 7 more companies with the investments are around 15,000 crores. The PCRA (petroleum conservation research association) under the ministry of petroleum and natural gas is doing commandable job to promote the oil conservation.

ELECTRICITY

It plays a dominant role in the progress and prosperity of our country.

Consumption of electricity is the barometer of a nation's economic well being and standard of living. The availability of abundant electricity means an unrestricted growth of industries, urbanization, transportation and agriculture. The first demonstration of electric light was conducted on July 24th, 1879 in Kolkata and the first hydel power plant was set up at Sidrapong for the Darjeeling municipality in 1897. But the true development of electricity was

seen only after the independence. The power sector registered an impressive growth by over 60 times during last 50 years. Inspite of that the per capita consumption in India is very low. It was 778kwh during September, 2012 whereas the world average is more than 71500kwh. And the developed countries like Sweden, US and Japan are having consumption of about 8,500kwh.

The total installed power generating capacity according to September, 2012 is 207.85GW or 2,07,850 MW. The thermal energy accounted for 1,37,936.18MW i.e., 66.63% of the total energy generated. According to 2011, 1,62,366 MW total power generated.

The thermal power includes generation of electricity from coal, gas and oil.

Coal – 1, 17,833.38 MW i.e., 56.92%

Gas – 18,903.05 MW i.e., 9.13%

Oil – 1,199.75 MW i.e., 0.57%

Hydel power accounted to 39,291.40 MW i.e., 18.98%

Nuclear accounted to 4,780 MW i.e., 2.3% of the total

Renewable accounted to 24,998.46MW i.e., 12.07% of the total.

During the 11th five plan, 54,964MW of installed capacity was added.

STATE WISE CAPACITY

THERMAL

Maharashtra ranks 1st followed by Gujarat, Uttar Pradesh, West Bengal and Madhya Pradesh. But within the state, Assam utilizes maximum of the thermal power which accounts to 99.6%.

West Bengal-98.5%

Mizoram-92%

Gujarat-91%

Bihar-90.1%

Hydel:

AP tops in hydel power generation followed by karnataka, TN, Punjab, UP. But within the state kerala tops with 100%

HP-99.5%

Meghalaya-96.4%

Sikkim-90%

Karnataka-79%

Nuclear:

India has got 50% of the world's total thorium deposits which is enough to generate 3,50,000 MW of energy for next 300 years. But the nuclear power contributes only to 2.3% of the total.

Nuclear power station

1. Rawatbhata, rajasthan: 1×100, 1×200, 4×220, 2×700(under process)
2. Kumharia, Haryana: 4×700
3. Narora, UP: 2×220
4. Kakrapara, gujrat: 2×220, 2×700
5. Mithirvidi, gujrat: 6×1000
6. Haripur, WB: 6×1000
7. Bargi, HP: 2×700
8. Tarapur, Maharashtra: 2×150, 2×540
9. Jaitapur, Maharashtra: 6×1650
10. Kaiga, Karnataka: 3×220, 1×220
11. Kowada, AP: 6×1000
12. Kalpakkam, TN: 2×320
13. Kudankulam, TN: 2×220

POWER REGIONS

The whole country has been divided into 5 power regions for proper management of production and distribution like.

1. northern region: it comprises of Punjab, Haryana, delhi, Chandigarh, rajasthan, H.P, J&K, uttarakhand and U.P. In this region there is a little demand supply gap present because this region consists of several of the thermal, nuclear and hydal projects.

2. western region: It includes Maharashtra, gujarath, M.P, chattisgarh, daman

& diu, dadra & nagar haveli and goa. This is the region having excess of electricity generation and this is the most industrialized and the urbanized region of the country.

3. southern region: it includes all the 4 southern states ap, Karnataka, kerala and tamilnadu along with puduchery and lakshadweeps. This region is the emerging region of industrialization and it is the most efficient services providing nation having the demand supply gap.

4. eastern region: Includes bihar, Jharkhand, Sikkim, west Bengal, Orissa and Andaman&nicobar islands. This was the early industrialized region of our country and it is having sufficient electricity production due to the thermal power projects.

5. North eastern region: This is the region spreading over all the 7 sister states of north east. The production of electricity is sufficient and most of the electricity generated is from the oil resources.

Non-conventional energy resources:

The energy produced from the NCERs is abundant, renewable, pollution free and eco friendly. The estimated potential of the NCERs in India is about 1,95,000 mega watts of which solar energy will be accounting to around 31%, ocean energy30%, bio fuel 26%, wind energy 13%. The energy self sufficiency was identified as the major driver in the country during the wake of the two oil shocks of the 1970s. The renewable energy program was started with the establishment of the department of non conventional energy resources (DNES) in early 80s. In 1987 the Indian renewable energy development agencies was constituted. In 1992, the ministry of non conventional energy resources was formed.

The solar energy:

India’s tropical location is an added advantage due to this it receives an average intensity of solar radiation equalent to 20 mega watts per sq.km per year or it is the potential equivalent to 5000 trillion kilowatts hour of energy per year but at present the solar anergy is accounting to less than 1% of the total energy produced in india. The 1st two pilot projects of 100 kilowatts potential each have been installed at Kalyanpur in Aligarh district and Saraisadi in mau district of UP. Two experimental solar power plants have been commissioned one at Salojipalle near Hyderabad with 20 kilowatts, the other near Delhi with 50 kilowatts of potential. The Asia’s largest solar pond is

near Bhuj at Madhopur with an area of 60,000 sq.m which has been recently inaugurated by Narendra modi and the name of the plant is charak pur which is also called as charanka having a potential of 214 megawatts but having a total plant capacity of 500 megawatts.

Wind power:

It is one of the earliest energy to be harvested by the human beings and for harnessing the wind energy only in the initial stages the cost inputs are required but once the power generation starts it will be cost free for next 20 years. TERI (tata energy resource institution) has estimated a potential of 50,000mega watts in coastal regions, 85 sites having a potential of 4500 megawatts have been identified in the coastal districts of the littoral states. Asia's largest wind farm cluster of 150 mega watts is located at muppandal in tamilnadu, 28 megawatt palnt at lamba in gujarath. Some of the other wind farms present in india are mandovi, gujarath-1.1 megawatt, tuticorin,tamilnadu550 kilowatts,okha,gujarath-550kilowatts, puri, Orissa and devgarh, Maharashtra each having 550 kilowatts. At present India is 5^{th} largest wind power producer of the world after china, US, Germany and Spain.

Bio gas:

By using the dung, the gas is produced. The technique involved is the biological breakdown of the organic material or the decomposition of the organic material in the absence of air.

Composition: in general it is said that the biogas consists of 55% methane and 45% of carbon di oxide but it includes 50-70% of methane, 30-40% of carbon di oxide, 5-10% of hydrogen, 1-2 % of nitrogen and traces of hydrogen sulphide. This gas has a higher thermal efficiency when compared to the fire wood, charcoal, dung or kerosene. The national project on biogas development (NPBD) was taken up in 1981-82 into the central sector. The ministry of NCER is promoting the setting up of institutional, community and family sized plants along with the night soil based plants. At present, the biogas saves several lakh tons fuel wood contributing to brown revolution and at the same time, it is yielding several million tons of organic manure contributing to the green revolution.

Geo thermal energy:

In India about 340 hotspring localities have been identified and some of them

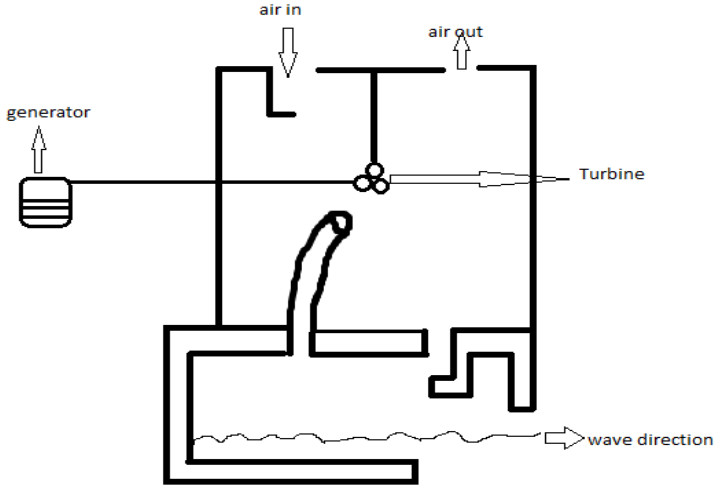
are having the temperature nearing to the boiling point. They are the ideal locations for setting up of geothermal plants. A 5 kilowatt geothermal pilot power plant has been set up at Manikaran in Kulu district of HP. A 5 megawatt plant is offing at the Puga valley in Ladakh.

Tidal energy:

It is estimated that India process a potential of more than 9000 MW of tidal energy generation. The gulf of combat is best suited with 7000 mega watts of potential where as the gulf of kutchch and sunderbans are having a potential of 1000 megawatts each because the tidal ranges in these areas is ranging between 10 to 12 mts of height. Already a tidal power plant is coming up at kutchch with 900 megawatts of potential with an outlay of 4000 crores of rupees.

Wave energy:

The potential of wave energy estimated in India is about 40,000 megawatts. A 150 kw plant has been installed at Vzhinjam nearer to tiruvananthapuram and a 1 megawatt plant nearer to the andamans has been installed.



OTEC-Ocean thermal energy convulsion

The estimated potential of ocean thermal energy is around 50,000 MW. Already a 100 MW plant costing about 750 cr is been set up at kulasekhara patnam nearer to the Chennai coast. In this method the temperature differences of different layers of oceanic waters are taken into consideration. The pressurized ammonium gas is pumped through the constricted pipes into the ocean deeps when the gas comes up through the vaporizer it rotates the

turbines which are connected to the electricity generator. The gas is collected and again compressed through the condenser and this goes on cyclically producing the energy continuously. We are at present generating the energy from

a. the urban waste- 1700 mega watt potential

b. industrial waste- 1000 mega watt

c. small hydro- 15,000 mega watt

d. baggasse- 5000 mega watts

by the end of 13th 5 year plan period we are expected to generate around 75,000 mega watts of power from

a. wind 40,000 mega watts (45,000 is the potential)

b. small hydro -6500 mw (15,000mw)

c. biogas bio mass – 7,500 mw (19,500)

d. industrial waste – 2000 mw (1000 mw)

e. solar energy-20,000 mw (jawahar lal Nehru national solar mission target)

the hydal power plants are called differently based on their capacities like

a. small hydro – 2 to 30 mw.

b. mini hydro 100kw-2mw

c. micro hydro – 10 kw-100kw

d. mico hydro – 1kw-10 kw

Demand supply gaps of energy resources:

1. coal:

By the end of 2012, the demand for coal is expected to touch 872 MT & the domestic supply is only 652 MT i.e., a gap of 220MT. By next year we are trying to minimize this gap to 120 MT by increasing the productivities or domestic supplies.

2. Crude:

At present the demand of crude is _____ and the production is only 0.9 million barrels per day. So we are having a self reliance of only around 20% & we are importing crude to an extent of 3.

3. Natural gas:

Demand is 216.4 million cubic cms per day & the production is 43.8. a huge gap of 172.6 mcm is seen.

4. Power demand:

- Production
- Peaking capability
- Peak load
- Generation capacity

Benefits of renewable energy:

- They provide better lightening with the inclusion of same costs.
- They help in environment protection since they are eco-friendly in nature.
- They provide sustainable fuel systems because they are renewable.
- Benefit the mankind & rural women in particular because their energy can be used for some productive purposes.
- Benefits the health. The corneal blindness & the respiratory diseases can be controlled.
- They enhance the income.

Aquatic resources

This includes both the freshwater and marine resources. They may be either biotic (fishes) or abiotic(minerals and energy). Fishing is one of the oldest occupations of mankind. It assumed much importance because of rapidly increasing population and depleting land resources. The fishes provide protein rich food and the A, B, D vitamins. There are about 30,000 species of fishes found in the world of which 18,000 species are found in the Indian waters.

The fishing which is done the offshore i.e., coastal waters and the continental shelf and the deep sea areas is called as the marine or sea fishing. The fishing in rivers, lakes, ponds, canals, tanks etc., constitute the fresh water

fishing or the inland fishing. This also includes the fishes obtained from the estuaries, the deltas, the back waters and the coastal lakes. India produces around 3% of the world fishes.

The marine fisheries:

India has a coast line accounting for 7517km. and its continental shelf spreads over 3,11,680 sq km. This entire area is suitable for the fishing purposes. 75% of the fish catch comes from western coast and 25 % from the eastern coast in India.

There is a vast scope of increasing the marine fisheries in India because the Indian Ocean is least exploited. Some of the important fishes caught from the Indian waters include shark, sardine, herring, anchovies, Mumbai duck, fly fish, ribbon fish, mackerel, ray, pearch, croaker, sole, carangid, tuna, silver belly and the Indian salmon etc.,

The handicaps or the disadvantages of fishing:

The disadvantages of fishing in india include..

The tropical climate: The fish cannot be preserved for long time. Hence the expenditure on deep freezing and refrigeration increases the fish price in India.

Banks are absent: The good fishing grounds or the banks are absent in the continental shelf area of the Indian coast.

Seasonal: The marine fishing is seasonal in nature because the strong winds in monsoons and the tropical cyclones in the winter season do not allow the fisher men to venture into the oceans.

Non mechanized boats: The fishing vessels in India are not perfectly equipped because most of the fishermen in India are illiterates who cannot operate the scientifically equipped machineries.

Lack of conditions: India is lacking the docking, freezing and canning facilities. Even if they are present, they are not in good conditions.

Market and transportation: There is no organized market and the organized transportation sector in India which are becoming the bottle necks for the development fisheries in India.

Variety of fishes: The species diversity is more in India because of the warm

tropical waters.

Fresh water or inland fisheries: Indian inland fishery resources are one of the richest in the world. The total length of fishable rivers is 27,359 km. fishable irrigation channels is 1,12,654km. The lakes and reservoirs cover over 29 lakh hectares of area, the coastal lakes cover 26 lakh hectares, the ponds-16 lakh hectares, piscicultural tanks- 6 lakh hectares. Kerala is the largest fish producing state with good fishing facilities and accounts for 22% of the total fish catch. Tamilnadu accounts for 21%, Maharashtra-12%, A.P- 10%, gujarath and Karnataka – 9% each. The fresh water fishes include barbus, clarius, mullets, etroplus, murrels, carps, cat fish, prawns and shrings etc., there are 4 main fishing harbours present in India.

1. Kochin, kerala.

2. Vishakhapatnam, A.P.

3. Chennai

4. Roychowk, Kolkata.

There are 23 minor fishing courts and 95 fish landing centers with good berthing facilities are present in India. The export items include frozen shrimps, frog legs, lobster tails, dried fish, shark fins etc., are exported to japan.

MINERAL RESOURCES

India is endowed with a rich variety of minerals. It has estimated that nearly hundred minerals are produce in India. Still, we have to depend on other countries for certain minerals. Hence, the mineral resources of India are grouped into 4 divisions.

A group: these are the minerals in which India has large surplus to export and dominate the world market. This group consists of iron ore, titanium, thorium and the rare earths.

B group: These minerals are said to be the exchange earners because these minerals are exported by india and they are contributing to the forex reserves and they include bauxite, manganese, granite, monazite and the refractory minerals (magnetite, kyanite and sillimanite).

C group minerals: These are the minerals which are present in enough quantities for the present level of growth and development of the industries

i.e., these are the minerals present in sufficient quantities and include the coal, cement raw material, building stone, dolomite, nitrate, antimony and precious and semi precious stones etc.,

D group minerals: These are the dependent minerals which are present in fewer quantities. Hence, India depends on the mineral imports and they include nickel, silver, cobalt, zinc, tin, mercury, tungsten, lead and platinum. The mineral sector accounts for about 3% of GDP and employs over a million of the people. Though mining is being in vogue for several centuries, the real development has occurred after the independence only. The 1991 liberalization policy gave an impetus to the mining sector. The new national mineral policy has conceded to the demands of the private sector.

The national mineral development policy has got some goals. To achieve them a number of government agencies and corporations have been set up. This is to oversee the development of the countries mineral resources. They include

- Coal India limited, Kolkata.
- Oil and natural gas corporation ltd., Mumbai
- National mineral development corporation, Hyderabad.
- Hindustan copper ltd., Udaipur, rajasthan.
- Hindustan zinc ltd., Udaipur, rajasthan.
- Bharath gold mines ltd., Bangalore.
- Uranium Corporation of india ltd., jaduguda, Jharkhand.
- Bharath Aluminium Company, dhamanjodi, odisha.
- National aluminum company (NAL), Bhubaneswar.
- Mineral Exploration Corporation limited, Nagpur.

The distribution of minerals and mineral belts:

The striking feature of minerals in India is their uneven distribution. Like the areas which are receiving high rainfall lack in limestone, gypsum and salt because these are the minerals either they will be dissolved in the water or may be washed off with the water flow. In the northern plains the thick alluvial beds are present but they are very poor in the mineral resources. The Himalayas have a variety of rocks and minerals but the geological structure is too complex and fragile. Hence, the viable technology is not available for the mineral explorations. Thus, the only rich mineralized zone with relatively sizeable quantities of minerals is confined to the old and crystalline rocks of the peninsular plateau and the low hills of the peninsular India. The minerals though unevenly distributed, they are present in well defined mineral belts

which are 5 in number. They are:

1. The north eastern peninsular belt:

This belt comprises of the chota Nagpur plateau and the Orissa plateau and it is spread in the states of Jharkhand, W.B and odisha. It is the richest mineral belt of India where the chota Nagpur plateau is called as the mineral heart of India or ruhr of India. It contains a variety of minerals like kyanite(100%), iron ore(50%), coal(80%), mica &chromite(around 70%) and also contains manganese, bauxite, copper, appetite, beryl etc.,

2. The central belt:

This is the 2nd largest belt encompassing the parts of M.P, A.P, Maharashtra and chattisghar. A comprehensive survey is still needed in this belt and this belt consists of the largest deposits of manganese, bauxite, limestone, marble, gems, mica, graphite etc.,

3. The southern belt:

This belt covers mostly the Karnataka plateau but extends into the T.N uplands and the rayalaseema of A.P. It is known for very limited mineral resources like iron and aluminium and it lacks coal except the lignite deposits at neyveli. It also lacks copper and mica.

4. The south western belt:

This belt comprises of goa and Karnataka. It is also known for very limited mineral resources ant it consists of iron ore, garnet and clay.

5. The north western belt:

This belt extends along the aravallis in Gujarat and Rajasthan. This is the recently developed belt and known for the non-ferrous metals like copper, lead, zinc and the precious stones like emeralds and salt. This zone is becoming an important producer of petroleum and natural gas resources.

Outside of these main belts, there are some other scattered belts present in the other parts of our country like Assam is known for lignite(coal) and petroleum, Himalayas known for coal, bauxite, copper etc., Mumbai high known for oil and natural gas which are also present in the KG basin. With the advancement of technology, even the sea bed is exploited for the mineral resources and at present we are obtaining the oil, natural gas, uranium, manganese, copper, lead and nickel etc., and most of them in the form of the

poly metallic nodules or the potato nodules.

As we know that the mineral industry is a robber industry, the conservation of the minerals is a must for the sustainable industrial development of our country. There are many cyclic minerals such as iron, copper, aluminium, tin, brass etc., which can be recycled helping in reducing the waste and the regeneration of the mineral resources (Japan, Britain and Italy are using the scrap for the production of iron and steel). We can also save the minerals by substituting the scarce minerals like copper with aluminium in the electrical industry.

Iron ore:

It is a metal of universal use and the backbone of modern civilization. According to the geological survey of India, the total estimated reserves are around 26 billion tons (15 billion tons of hematite and 11 billion tons of magnetite). 95% of the total reserves are present only in 5 of the states like Jharkhand-25%, Orissa-21%, Karnataka-20%, chattisgarh-18%, goa-11%. Depending on the iron content, 4 varieties of iron ores are recognized. They are :

1. Magnetite: It is also called as the ore of black mineral. Chemical formula Fe_3O_4. It is the best quality of ore containing more than 72% of pure iron. Because of its magnetic property, it is called as the magnetite. The total exploitable reserves identified in India are around 10,169 million tons (around 11 billion tons) and it is found in Karnataka-74%, A.P-14% and rest in Jharkhand, goa, kerala and tamilnadu.

2. Hematite: It is called as the red mineral because most of this we get from laterite soils. Chemical formula is Fe_2O_3. It is the mostly found ore of iron containing 60-70% of the pure iron. The total recoverable reserves accounts for 14,630 million tons & 95% is present the 5 states like Orissa, Jharkhand, chattisgarh, Karnataka&goa.

3. Limonite: Brown or yellow mineral. It is also called as hydrated hematite with the chemical formula $Fe_2O_3.H_2O$. It contains around 40-60% of pure iron. The yellow colour is due to its reaction with water.

4. Siderite: This is called as the ash grey mineral. Chemical formula is $FeCO_3$ i.e., it is the carbonate of iron. It is the most impure form of iron ore with only around 40% of pure iron present in it. India has about 5.5% of the world iron ore reserves and our production is increasing regularly. Earlier, Jharkhand

was the largest producer but now it is excelled by Karnataka, Orissa, chattisgarh and goa in the same order.

Karnataka:

It is the largest producer accounting for about 25% of the total production. Since 1980 onwards the production of Karnataka increased by 3 times. Iron ores are widely distributed. But the best grade ore deposits are present in pemmangundi in the bababudarhills of chikmagalur and the sandur & hospet of bellary.

Orissa:

It produces around 22% of the total production and the important deposits occur in sundargarh, mayurbanj, Cuttack, sambalpur, keonjhar & koraput districts etc., India's richest hematite deposits are located in barabil-koira valley extending in gurumahisani, sulaipet & badampahar areas of mayurbanj district.

Chhattisgarh:

Though the reserves are only 18%, the production is around 20%. The production comes from bailadila in bastar district & dallirajhara in the durg district. The vizag port is a handy port for exporting the ore from Chhattisgarh.

Goa:

Comparatively a new entrant into the iron ore production. Though it contains only 11% of total reserves, it produces around 18% of the total. Goa is known for most efficient exploitation because it uses most modern & sophisticated machinery. The richest of deposits are present in northern goa because it is having an advantage of river transportation or the rope way transportation. Most of the iron ore is exported to Japan from the marmagoa port. The important deposits occur in pirna-adolepale-asnora region.

Jharkhand:

It accounts for 25% of the reserves but produces only 14% of the total. The then bihar use to occupy the prestigious place as a largest producer in India and also having a distinction of the 1st scientific mining which started in 1904 in the singbum district. The iron bearing belt of Jharkhand extends for 50km from Gua in jharkhand to pantha in Orissa. The areas in Jharkhand include budhubaru, kotamandi & rajoribaru of singhbum.

Exports:

India is the 5th largest exporter of iron ore in the world. 3/4ths of the exports goes to Japan & the rest to S.Korea, EU & lately to gulf. The major ports handling the iron ore exports are vizag, paradweep, marmagoa, mangalore. The increasing demand in domestic market is adversely affecting our exports. Efforts are being made to increase the production and to earn the much needed forex.

Exports

Years	1960-61	1970-71	1980-81	1990-91	2000-01
1000 tons	3.2	21.2	22.4	32.5	20.08
Value(cr)	17	117	303	1049	1634

Copper:

As a metal it came into use much earlier than iron. The copper utensils and the coins were used in the world from a long time.

Being a good conductor of electricity, it is extensively used in a vast variety of the electrical machineries, the wires and the cables.

The amalgams of copper, which are very light & strong are used in the automobile, defense and the space industry.

The alloys of copper:

Steel: copper+nickel+iron

Monel or morel metal: copper+nickel

Duralumin: copper+ aluminum

Brass: copper+ zinc

Bronze: copper+tin

The copper ore is found in the ancient as well as the younger rock formations. It occurs in the veins and the bedded deposits i.e., the sedimentations. Mining of copper is a costly & tedious affair because the copper ores contain very little percentage of the metal. In India, the metal percentage is less than 1% of total ore & the international average is around

2.5%.

Production & distribution:

Regarding the reserves & the production, India is very unlucky. The total estimated reserves in India are 1.39 billion tons, equivalent to 11.41 mT of metal content. 98% of the total reserves are concentrated in only 3 states: Rajasthan, Jharkhand, M.P.

The production was only 3.75 lakh tons in 1950-51 & increased to a maximum of 52.55 lakh tons & got decreased tremendously to around 1.5 lakh tons in the early 2000's.

Important producers:

1. M.P:

It has become the largest producer of copper in India, surpassing Rajasthan & Jharkhand in the 1990's. The large belt of copper is seen in 'taregaon area of malanjkhand belt of balaghat district'. & moderate reserves are found in kherli bazaar-bargaon area of vetul district.

The ore estimated in M.P is around 84.43 mT with a recoverable metal reserve of 10 lakh 6 thousand tons.

2. Rajasthan:

It is the 2nd largest producer. Most of the reserves are found along the arravalli ranges spreading over the districts of ajmer, alwar, bhilwara, chittourgarh, jhunjhunu, udaypur etc.,

The khetri-singana belt in jhun jhunu is most important copper producing area runs for 80kms.

Kho-dhariba is about 48kms to the SW of alwar city.

Delwara-kirouli area in uday pur etc., are also important.

Jharkhand:

It used to be the largest producer till 1980's but slipped to the 3rd position. Singbum is most important district and the areas are rakha, surdar, dhobhani, morsabhani. In hazaribhag district, the areas are hasatu, baraganda, parasnath, barjanath etc.,

Imports:

Our production is too short of our requirements and the import quantities are varying year by year and the major supplies come from USA, Canada, Zimbabwe, Japan & Mexico.

Limestone:

It is associated with the rocks composed of either calcium carbonate, the double carbonate of calcium & magnesium or the mixture of two. It also consists of small quantities of siliea, alumina, iron-oxides, sulphur & phosphorous. It is of the sedimentary origin and exists in all the geological sequences from the pre-cambrian to the recent, except in the gondwana formation. The estimates total reserves present in India are about 1,75,345 mT.

Uses:

It is used in a variety of purposes & nearly 75% is used in cement industry alone.

In iron & steel – 16%

In chemical -4% and the rest is used in the fertilizers, rubber, glass, paper & the sugar industries.

Although all the states in India produce some quantity of limestone, 3/4th of it comes from 6 states: M.P, A.P, T.N, Rajasthan, gujrath, chattisgarh.

M.P:

M.P is the largest producer of limestone and accounts for over 16% of the total. The reserves estimated are around 1500 mT and the deposits are present in the districts of jabal pur, santar, betul, sagar, damoh & reva

Rajasthan:

It produces a little over 16% of the total limestone and the deposits are present in jhun jhunu, bhansvara, bundi, Ajmer, udaypur and Pali.

A.P:

It was the 2nd largest producer but slipped down to the 3rd position. It accounts for 1/3rd of the total cement grade limestone of India, but produces about 16% of the total. The extensive deposits occur in Kurnool, kadapa, Guntur,

Krishna, nalgonda, adilabad etc.,

Gujarat:

It produces about 10.8% of the total. The high grade limestone deposits are present in the banaskanta district. The deposits come from amreli, kutch, surat, junagarh etc.,

Chhattisgarh:

It accounts for around 9% of the total production and the deposits are present in bastar, vilaspur, rai garh, Raipur & durg districts.

TN:

Large scale reserves are present in ramnathpuram, tirunelvelli, salem, coimbattore, & tanjore. It constitutes about 8.7% of the total production.

Diamonds:

They have been highly valued & cherished through out the ages because of their brilliance, luster, transparency, adamantine & hardness. They are widely used for ornaments and for polishing the surface metals and for cutting the gems and minerals. The most important industrial use of diamonds is in the cutting edges of the drills used for exploitation of oil and natural gas and mining of minerals. The production was only 1674 carattes in 1950 and it has touched the mark of 1 lakh carattes in 2009. The diamond bearing areas are:

in A.P: wajrakarur, kimberlitic pipes in the anantpur district and in the gravels of R.Krishna.

in M.P: panna belt

in chattisgarh: the dimendiferous kimberlitic pipes.

New fields have been discovered in raichur, Gulbarga districts of Karnataka. The cutting and polishing industry is very well developed in Surat, navsari, Ahmadabad, palampur, Bhavnagar & mehsana etc., Mumbai, goa, jaipur & trichur are the new centres developing for polishing.

Kyanite:

It occurs as metamorphic aluminous rocks and primarily used in ceramic, metallurgical refractory & a host of other industries. Its important characteristic feature is its ability to withstand higher temperatures. Hence,

used in the making of spark plugs. India has the largest deposits of kyanite in the world and found in 3 grades depending on the percentage aluminum present.

1st grade: contains 62% to 64% of aluminum.

2nd grade: contains 58% to 62% of aluminum

3rd grade: contains 54% to 58% of aluminum.

The total reserves estimated in India are about 103 mT.

Production and distribution:

Production is fluctuating. Till 1990s, it was more than 35,000mT but afterwards it has drastically fallen to 5000 to 6000mT. 100% of kyanite is practically produced from Jharkhand, Maharashtra & Karnataka only.

Jharkhand:

It is the largest producer of kyanite and produces around 80% of the total. The ores with higher degrees of purity of around 95% to 97% of alumina are present in singbum. The other areas include badia, bakra, mohanpur, jagnathpur, hatiland, singpura etc.,

Maharashtra:

Most of the deposits are from bhandara and Nagpur and the estimated reserves are around 70,652 tons.

Karnataka:

Although it is the 3rd largest producer, it contributes only around 5.5%. The Hassan district has corundum kyanite rocks containing 63% to 65% alumina. The estimated reserves are 6, 31,177 tons. It is also produced from chikmagalur, chitradurga, mandya, Mysore & shivmogha.

INDUSTRIES

Industry is the hall mark of economic growth and the industrialization is a part of the developmental strategy. Industries are the manufacturing units i.e., the processing of primary products into more refined and useable products is been done here. Many of the natural resources cannot be utilized directly without converting and processing. So, the industries do the job of transformation of natural materials into the commodities of utility. Industries

work as the engines of growth helping in employment generation, removing the poverty and transforming the traditional society into a modern one. All the developed countries are the highly industrialized countries.

Historical perspective: In the early times, India's handicrafts were manufactured in the houses and huts all over the country working on the locally available resources. Generations of such workers provided India with a long and glorious tradition of artistic handicrafts. Indians knew the weaving some 1500 years B.C. The iron column near qutub minar shows the excellence of our metallurgy. It is believed that the Damascus blades were made from the steel imported from India. Indian cotton textile, the calico printings and the dyings of India were famous throught the world along with the carvings of stone, wood, ivory and the works of bronze, brass, silver, copper and pottery. The industrial revolution in Europe resulted in the modern factories which eroded the strong traditional industrial base of India. The self sufficiency of villages was broken by the British rulers and their policies have destroyed the viability of the urban handicrafts.

The rise of modern industry:

The decline of traditional industry and the rise of modern industry were not casually connected. The beginning of the modern large scale industries in India dates back to 1818 where a textile mill was started at fort gloster, Kolkata and then in 1830, the 1st charcoal fired iron making was attempted at prto niva in tamil nadu. Both got closed down. So the real beginning is recognized with the establishment of the cotton textile industry at Bombay during 1854 by a local parsi entrepreneur named C.N.Davar. The cotton textile industry has grown tremendously in 1870s due to the American civil war and by 1875-76 the number of cotton mills increased to 47.

The 1st jute mill has come up at kishra in Kolkata during 1855 and this was by George aukland. Then after several industries developed including the woollen textiles, paper mills, foundaries and the brewaries etc., the main industrial centers wer the port cities of mumbai, Kolkata, Chennai and the sole inland industrial center was Kanpur which was the base for the military equipment production.

The inter war period:

The Indian industry grew very rapidly during the 1st world war because the demand for industrial goods was on rise for the allied forces. The real spurt was provided by the Indian fiscal commission which was set up in 1921-22.

This gave a much needed protection to the industries like iron & steel, textile, cement, sugar etc., and during this period the dispersal of the cotton textiles taken place at a faster pace. India emerged as the 4th largest cotton manufacturing country.

2nd world war:

The 2nd world war has created problems for the Indian industries. However the impact of war was short lived and the industry got benefitted by the war. In 1941, a program for manufacturing of explosives and armaments was launched, heavy chemical industry was also started and the 1st aircraft was assembled by the Hindustan aircraft company. The steel, the chemical, the paper and cement industries recorded an impressive growth.

The post war and partition:

This period was characterized by many ups and downs. There was an overall decline of the industrial production because of the fall in demand. The overworked machinery, the labor troubles and some of the other bottle necks of transportation and distribution were the cause factors of decline. The partition of India gave a severe blow to the industries because Pakistan accounted for 23% of the area and 18% of the population but got 40% of cotton growing areas and 81% of the jute producing areas. Further India suffered losses in terms of market as well as the skilled labor. However India retained most of the basic industries. The situation improved in 1948 because of the industrial policy resolution after a lull of 2 years. The policy directed the development of the Indian industries with tax concessions and active state help by setting up of industrial finance corporation.

Factors influencing the location of industries:

There are several factors which are influencing the location of the industries. They can be broadly divided into two categories. They are:

1. The geographical factors.

2. The non-geographical factors.

The geographical factors:

These are the factors which are essential for setting up of an industry and also for the sustenance of it. They include

1. The raw materials:

Many a times the location of an industry is determined simply by the availability of the raw materials. Sometimes the raw materials of one industry are the finished products of another industry. Generally the industries which use heavy and bulky raw materials are usually located in the vicinity of the raw material occurring areas. Some of the industries are called as the foot loose industries because they do not require any specific locational factors.

2. Power:

The regular supply of power is a prerequisite for the localization of the industry. The iron and steel industry requires large quantities of coking coal as the source of power. Hence, those industries are tied to the industries of coal field. The electro metallurgical and the electro chemical industries require huge quantities of electricity. Hence they are located nearer to the cheap hydro electric power staions.

3. The labor:

The priority of the labour force which no one can deny in the setting up of an industry. Inspite of the mechanization the modern industry in our country still requires large number of workers. Generally the location of any industrial unit is determined by balancing many of the relevant factors. Yet the light consumer goods, the agro based industries etc., require plentiful of the labor force.

4. The transportation:

It is necessary either for assembling of the raw materials or for marketing of the finished goods. The development and construction of railways have played a major role in the industrial development of our country. Even the improvement of the communication facilities also has developed the industries to a much extent.

5. The market:

The entire process of manufacturing is useless until the finished goods reach the market. Now a days the market attraction is playing a dual role for localization of an industry i.e., as the market and as the source of raw materials. The perishable goods and the heavy commodities require ready market.

6. The water:

Many industries are located nearer to the rivers, canals or the streams etc., because they require huge quantities of water. For ex: The iron and steel industry requires water for cooling purposes. The textile industry requires for washing purposes. The chemical industry requires for solutional purposes etc.,

7. Site:

The site generally should be flat and well served by adequate transportational facilities along with future scope of development. Now a days the industries are moving away from the urban centers due to the higher land values.

8. Climate:

Harsh climate is not suitable for the establishment of the industries. Many of the climates will be acting as the potent constraint for the setting up of the industries. For ex: The arid and dry climate will deter the cotton industries where as the humid climate deter the iron and steel industries.

Non geographical factors:

Now a days the alternative raw materials are being used because of the available scientific and technological advancements. Even the power is available for the wider areas and also the labor has become more mobile in nature. All these factors have reduced the influence of the geographical factors and the non geographical factors are gaining the importance. They include

1. Capital:

The modern industries are capital intensive in nature and require large investments and because the capitalists are available in large urban centers, they are becoming the biggest industrial attractants.

2. Government policies:

Governments plan and formulate certain policies for reducing the regional disparities, for the elimination of pollution and for avoiding the heavy clusterings of the industries in the bigger cities. The government policies have become important locational factors because each and every state governments industrial policies differ from another by giving subsidies and incentives in the form tax holidays, providing free land and good

infrastructural facilities etc.,

3. Industrial inertia:

Industries tend to develop at the place of their original establishment though the cause has disappeared. Many a times the inertia provides the required thrust for the growth. If a big industry is set up several of the auxiliary industries come up and they go on serving.

4. Efficient organization:

This is very essential for running a modern industry successfully. The bad management squanders away the capital and puts the industry in the financial trouble ultimately leading to the labor unrest, strikes and the lock outs of the industries.

5. The banking facilities:

Establishment of the industry involves the daily exchange of crores of rupees for which the bank facilities are essentially required because they give the legal sanctions.

6. The insurance:

There is a constant fear of damage to the man or machinery in the industries for which the insurance facilities are badly needed to save the management and to serve the employees.

Classification of industries:

Based on labor: * large scale ex: cotton, jute

* Medium scale ex: garments, bicycle, t.v etc.,

*small scale ex: bakers, confectionaries

Based on raw materials: * heavy industries ex: iron& steel

* light industries ex: electrical, sewing machines etc.,

Based on ownership: * private ex: tisco, bajaj

* public ex: BHEL, BEL, HMT etc.,

* joint ex: OIL, gujrat alkalies etc.,

Based on source of raw materials:

Agro based: cotton, jute, sugar etc.,

Mineral based: iron & steel, cement etc.,

Pastoral based: hides, bones, horns etc.,

Forest based: paper, silk, lac, basketary etc.,

Miscellaneous industries:

Village industries: oil extraction, rice shelling, flour milling etc.,

Cottage industries: handloom, khadi, leather artifacts etc.,

Consumer industries: garments, bakers etc.,

Ancillary industries: components for other industries

Basic industries: power, iron & steel etc.,

Capital intensive industries: cement, iron & steel, aluminum etc.,

Labor intensive industries: shoe making, beedi making, garments etc.,

Textiles:

Cotton textiles:

Textile industry is a broad term which includes cotton, jute, wool, silk & synthetic fibres etc., They together account for 30% of total exports. Textile industry is the oldest among the modern factory enterprises.

India held world monopoly in manufacturing of cotton textiles for above 3000 years from 1500B.C to 1500 A.D. the muslims of Dhaka, chintezes of masulipatnam, the calicas of calicut etc., have acquired a world wide fame in the middle ages. The industry could not survive strong competition from the modern mills of Britain which enjoyed the political advantages.

The 1st modern cotton textile mill was set up in 1818 at fort gloster near Kolkata but was closed down. The successful modern cotton textile industry was established in Mumbai during 1854 by a local parsee entrepreneur named C.N.Dawar.

Till 1914, 60% of the cotton textile industries were located in Bombay city

alone.

The 1st world war gave a boost to the cotton textile industries and our exports reached to many of the world destinations.

But by 1924, Japanese goods displaced the Indian exports from china and by 1930s, they flooded the Indian market.

In 1931, the then British Indian government has imposed 40% of the import duty which increased to 75% by 1933.

In 1934, there was an indo-Japan agreement which put the quota system for imports.

During 1947, the industries suffered a serious setback because the mills remained in India and the growing areas went to Pakistan. Because we had limited foreign reserves, we could not import the long staple cotton at that time. The only solution for that problem was to increase the hectarage and production of the long staple cotton. This was achieved to a great extent in the post partition era.

The Korean war of 1950-51 created a boom for cotton textiles of India.

The cotton textile industries are divided into 2 broad sectors.

1. De-organized sector: it includes handlooms, powerlooms & khadi.

2. Organized sector: it includes the spinning and weaving mills together.

At present, this is the largest modern industrial sector in India, which contributes to about 14% of the value addition in manufacturing sector, about 16% of the industrial labor & 4% of the GDP of the country.

This is the most decentralized sector where 95% of the production comes from de-organised sector and 5% from organized sector, which used to produce around 80% of total cloth in 1950-51.

Locational factors:

At present there are 1719 textile mills in India. (188 in public sector, 147 in co-operative sector, 1385 in private sector). There are several thousands of small factories engaged in the cotton ativities. Several of the factors play a key role for the localization of industry. Among them, the market, transportation & the raw materials are of significance. But, the significance of

the raw materials is evident from the fact that 80% of the industries are located in the cotton growing tracks of India.

The cotton is a pure raw material which does not loose weight during the manufacturing and there is no much difference between the cost of transporting raw cotton or the cloth. So, this industry normally tends to locate in such centers which have favourable transportation facilities.

Though the industry was concentrated in and around Bombay, it has witnessed a great spread and it almost covered the entire country,

The dispersal of the industry started after 1921 due to the fiscal commission due to the opening up of railway lines due to the availability of hydal power etc., but the localization is only in some of the areas where as the other areas are completely secluded.

Distribution:

The industries are largely concentrated in Maharashtra, Gujarat, U.P, W.B, T.N. but are located only in 80 of the urban centers.

Maharashtra:

It ranks 1st by producing 30.38% of the mill cloth and 10.79% of the yarn in India. Mumbai had 63 mills out of the total 123 mills of the state and it is called as the cottonopolis of India.

Facilities enjoyed by Mumbai:

- It enjoys humid climate which helps the industry because the humidity does not break the thread frequently.
- The most important port location. This helped it to import the machinery, long staple cotton and export the cloth.
- It enjoys cheap hydal power from the near western Ghats.
- The black cotton soil in the hinter land for the raw material production favoured it.
- Mumbai attracts cheap and skilled labor from various corners of the country.
- There is a ready market for the products made in Mumbai, both in India and abroad.
- Mumbai is well connected by all the types of transportation networks.
- Because of its coastal location and the abundance of water availability facilitated the washing and dyeing works.

- There is no dearth of capital inputs. Mumbai is the financial capital of India having largenumber of entrepreneurs.
- It enjoys the industrial inertia which was the British legacy.

Apart from Mumbai, the other cloth producing centers are Sholapur, Kolhapur, pune, satara, Aurangabad, amaravathi, jangaon etc.,

2. Gujarat:

It is the 2nd largest producer of cotton textiles and account for 33% of the mill cloth and more than 80% of the yarn production. Ahmedabad is the second largest producer of cotton textiles after Mumbai. The other important centres are present at surat, vadodara (baroda) and Rajkot, Maurvi, Porbandar and Bhavnagar etc.,

3. Tamil nadu:

Among the southern states Tamil nadu is the important producer. It produces around 6% of the mill cloth but about 44% of the yarn.

Coimbatoor is called as ‘Manchester of the south’, having ‘200 mills out of 439’ in tamilnadu.

But the sizes of these mills are very small. The other important centres are:- Chennai, Madhurai, Tirunalveli, Tirchunapalli, Salem, perambur and tuticorin etc.,

4. West Bengal:

Though the 1st modern textile industry began in kolkatta, the entire west-bengal has a disadvantage of being away from the cotton producing areas.

5. Uttar Pradesh:

Most of the cotton textile industries have developed in western part of UP. Kanpur is called the Manchester of UP.

The problems of cotton textile industries:-

1. The scarcity of raw materials: India does not produce the long staple cotton in required quantities. Hence, we mostly depend on the imports.

2. Obsolete machinery: The machinery used in cotton textile industry is out-dated and only 18 to 20% of industries in India are automated with high

technology [pakistam-60%, Bangladesh-80%, Hong kong , USA, Canada etc.,-100% automated industries].

3. Power supply: It is erratic in nature. There are large fluctuations in the power supply and many a times, it is non-continous in nature.

4. Low productivity of labour: The indan labour handles about 2 looms when compared to more than 40 looms in Japan and 60 looms in USA.

5. Stiff competition:- The mill industry is facing competition from the powerlooms and handloom sector of India and the synthetic fibre from abroad.

6. Sick mills: As many as 177 mills have been declared sick prior to 1975. The" National textile corporation" was set up in 1975 to take care of the sick mill of our country. This has taken over the administration of 125 sickmills and all of them are running in profits now.

TECHNOLOGY MISSION ON COTTON -2000.

This mission is having "4 mini missions" and the programs under these mini missions are implemented by the "ministry of textiles,govt of India", through the cotton corporation of India limited.

Mini mission -1:

This is for the development of short duration high yielding, disease and pest resistance hybrid seeds.

Mini mission -2:

It takes care of the technology transfer through training and demonstration and also for the de-linted certified seeds.

Mini mission-3:

It takes care of the improvement of the marketing, infrastructure and the implementing agencies.

Mini mission-4:

It is for the modernization & technological upgradation of the existing industries.

Exports:

The exports of cotton textiles is put under the open-general category. India is the major exporter and the important items of exports include: the cotton yarn, the cloth and ready made garments. The exports of ready made garments is increasing tremendously from 1960's onwards and in the past 3 years, the growth rate of exports is increased about 10-12% in the dollar terms.

The share of the garment exports increased to 25 billion $ in 2010. Though the cotton exports are under the open-general category, the government allowed the exporters to export only 55 lakh bails in the past season with an export duty of Rs.2500/ton. The textile industry in India is stronger in position and has recorded 16% of accelerated growth rate of value which will be amounting to 220 billion $ by 2020.

The investments into the cotton textile industries have increased tremendously and are nearly touching 1,50,600 cr. by the end of dec.,2012.

The area under cotton crop and the yields per hectare are increasing gradually since 1950-51. During 1950-51, 56.48 lakh hectares of area was under cotton cultivation and the production was 30.62 lakh bails with the average yields of about 92 kgs/hectare.

During the last season i.e., 2010-2011, the area increased to 110.55 lakh hectares and the production increased to 329 lakh bails with the average yields of 526 kgs/hectare.

The average yields of certain states are as follows:

TN- 817 kgs/hectare

Gujarat-635 kg/hectare

A.P - 599 kg/hectare

Maharashtra–306 kg/hectare

Maharashtra produces around 26.33% of the total cotton of India.

Gujarat-17.96%

A..P-13.79%

India is the 2nd largest producer after china followed by USA, pak and brazil.

IRON AND STEEL INDUSTRY

It is a metallurgical industry. The metallurgical industry are those which use metal or the metallic mineral as the basic raw material and they form the backbone of the developing countries.

Iron is the most important and widely used metal in the service of man. The machine civilization of modern age would not have existed without iron.

The sturdy structure of modern industrial world is made up of steel.

Most of the subsidiary industries such as the automobiles, locomotives, ship buildings, machine buildings, infrastructural enhancements and a host of other commercial activities depend on the iron and steel.

The per capita consumption of iron and steel is a yard stick for the measurement of the level of industrialization and economic growth of the country.

Generally, we get iron in 3 forms

1.Sponge iron: it is in the form of lumps and pellets entrapping the natural gas.

2. Pig iron: it is the intermediate iron and because of the higher carbon and carbondioxide content, it is brittle in nature.

3. Wrought iron: It is the best quality iron and very costly in nature. It is also non-corrosive.

Different processes of iron and steel production:

1. Blast furnace or basic oxygen furnace process: This converts the iron ore into the liquid form having high amount of the impurities that is the pig iron.

2. Electric-Arc furnace: This process re-melts the sponge and scrap to produce the iron and steel.

3. Corex or cipcor process: This process makes the possible the use of non-cooking coal directly in the smelting works and it uses the lump and pellet as the inputs.

The cooking plant which converts the non-cooking coal into more efficient fuel

that is the ‘coking coal’and

The sinter plant which purifies the lump ore and pellets are both eliminated.

4. Induction Arc furnace: It is the most advanced, most efficient and eco-friendly process. But lacks refining capacity that is this process requires the clean and pure products as the inputs.

The Indians knew the technique of smelting iron since early times but the 1st unit on modern lines was set up in 1830 at portonova in TN but was closed in 1866. A humble beginning was made by setting up of the “kulti plant” in WB in 1864. But the real beginning of the modern industry was made in 1907 with the establishment of tata iron and steel company (TISCO) at sakchi in beerbhum district of the then bihar. Now it is called as Jamshedpur, present in Jharkhand. Then came the Indian iron and steel company (IISCO) in 1919 at burnpur.

In 1923, the mysore steel works has come up at bhadravati. The industry increased very rapidly after independence. At present, India is 4th largest producer of iron and steel in the world after china, Japan & USA.

But by 2015, we will be the 2nd largest producer. India produced around 16.91 lakh tons of iron during 1950-51.

The locational factors:

The iron and steel industry uses large quantities of heavy and weight loosing raw materials and hence its location is primarily controlled by the availability of the raw materials like coal and iron ore. So, the industry was previously located at 3 distinct places like

Nearer to coal fields

Nearer to mining areas

Place in between coal fields and iron ore centers.

Hence many of the industries were located in and around Jharkhand. The other raw materials used are used in small quantities. Hence, they does not effect the localization. They are: manganese, limestone, dolomite, chromite, silica etc.,

The another important factor influencing the location is the market. The steel products are bulky and it has been estimated that the transportation cost per

ton per km of steel is 3 times than that of coal and iron ore. Thus following the theory of minimum transportation costs, many of the industries are attracted towards the markets.

The infrastructural developments in transportation, the use of scrap as raw materials and the agglomeration economies have made the market oriented locations to be more advantageous than even before, the markets have double attraction as a consumer and as a source of raw material.

So, for location of the iron and steel industry, 3 areas have equal importance like coal mining center, iron ore area and the market.

In another situation, many of the industries are offing seaport locations because some of the ingredients have to be imported and the finished products have to be exported. Hence, Visakhapatnam, paradweep, gopalpur, manglore and ratnagiri etc., are the new locations.

The centers of production:

At present there are 10 primary integrated steel plants and a large number of decentralized mini steel plants and about 10,000 foundries are present in India. Foundries are the places where smelting is done and different steel items are manufactured there.

95% of the foundries are concentrated in Maharashtra, Gujarat, T.N.

The integrated steel plants present in India are:

TISCO:

It has been renamed as the Tata steels after taking over the corus steel company. This is the oldest and the largest steel center present in India located at Jamshedpur. During 2008-09 it was producing around 40 lakh tons of the saleable steel but is planning to increase the capacity by 33-34 million tons per annum till 2015, this will be done by increasing the capacity of Jamshedpur plant from 5-10mT. and a 12Mt per annum project is coming up at Jharkhand, 6 Mt per annum project at Orissa and 5 mT per annum project in Chhattisgarh are also offing.

Locational advantages of TISCO:

1. It gets high grade hematite ore from nao-mundi mines (singbhum district, Jharkhand) gurumahisani mines(mayurbanj district, Orissa) within a radius of

75-100km.

2. Gets coal from jharia and raniganj fields of WB in a radius of 200km.

3. Manganese from joda mines of kiyonjhar(khendra pada/keonjhar) district.

4. Limestone, dolomite and fire clay from sundargarh district of Orissa.

5. The market and the port facilities is offered by Kolkata – 200km apart.

6. Water for cooling purposes comes from Subarnarekha.

7. The transportation facilities are in the form of network of railways and roadways.

8. Cheap labor from the vicinity. The extension of TISCO was set up at gopalpur-170 km away from bhuvaneswar.

The gopalpur enjoys,

- Coastal location
- Proximity to the rich iron ore belt.
- Availability of the land
- Riverlet near by for the water purposes
- Good transportation network.
- The minor deep port can be expanded for the future purposes.

2. IISCO:

The three plants present at kulti, hirapur & burnpur ofW.B which were set up in 1864, 1908 & 1937 respectively merged together to form IISCO and came under the control of government in 1972 and are linked by the Kolkata, asansol railway line(the IISCO was formed in 1919 by the merging of kulti and hirapur plants).

The hirapur produces the pig iron & sent to kulti for making steel and the rolling mill facility is present at burnpur. These 3 are interlinked with the wagon transport. The wagons will be carrying steel to the burnpur and in return they get they iron ore from burnpur to hirapur.

IISCO has come up with annual capacity of 10 lakh tons of steel, but by the end of 2011, its capacity got increases to 10 mT.

Locational advantages of IISCO:

1. Iron ore: guno mines, singbhum, guru mahi sani mines, mayur banj

2. Coal: jharia, but now DVC(damodar valley corporation) hydal power.

3. Dolamite & limestone – sundargarh

4. market and port – Kolkata

5. cheap labor vicinity

3. MISCO (Mysore iron and steel company):

It was established in 1923 at bhadravathi in shivmogha district. In 1962 it got renamed as visweswaraiah iron and steel company ltd(VISL). It mainly produces special and alloy steel and its capacity is 1.3 lakh tons but planning to raise upto 2 lakh tons.

VISL being the only steel plant in south India, it enjoys the undivided large market.

LOCATIONAL ADVANTAGES OF MISCO :

1) Iron ore: - Kemmangundi mines, ehigmuglur.

2) Charcoal: - from forest wood- previously and now hydel power: from sharavati river.

3) Limestone: - Bundiguda.

4) Manganese: - chitradurga.

5) Water: - Badravati and tunga rivers.

6) Transportation artery: - Birur, shimoga railway line.

After Independence, in order to increase the production and propel the industrial development, Iron and steel industry was given a major thrust by the government. It established the Hindustan Steel ltd. in public sector. Under this, in 2nd 5 year plan, 3 of the plans have been set up each at Bhilai, Rourkela, Durgapur.

In 3rd 5 year plan, Bokaro has been setup each with capacity of 10 lakh tonn/annum.

STEEL PLANTS

1) BHILAI STEEL PLANT: It was set up in Durg district of present Chhattisgarh in 1957 and the production was started in 1959. It has come up with the technical support of Soviet union. Its capacity got increased to 10 million tons per annum in 1997-99.

2) ROURKELA STEEL PLANT: This was set up at Sundergarh with the help of west german firm called “KRUPPS AND DAMANG” production started in 1959. Its present capacity is 3.5 million tones.

3) DURGAPUR STEEL PLANT: Set up at Bardhaman district of west Bengal in 1959 with the technological support of UK. Production started in 1962. At present it has a capacity of 3.5 million tones.

4) BOKARO STEEL PLANT: It was set up at Hasaribagh district near confluence of the river Bokaro with Damodar. In 1964, with the technological support of soviet union production started in 1972. At present, it is having a capacity of 10 million tons.It has taken very long time to start the production.

SETTELMENTS

Shelter is the most important need of the people after the food because, we have to protect ourselves from the vagaries of the nature and from the wild and also to enjoy the Social life. The sites of the settlements are closely influence by the availability of portable water, fetile soil or with mineral and forest resources.

The settlements may be either temporary or permanent and about 3.5% of the total world population are migratory or nomadic in nature who are having the temporary settlements. In general, the people who live in the deserts, the semi deserts or the Alpine Tundras will be practicing the Nomadic types of settlements.

For Eg: - The Gujjars(cattle) and Bakkarwals(sheep and goats) of Jammu and Kashmir, live in Kothas and Bandis.

The permanent settlements are the settlements which are generally present in the areas where the settled agriculture is practiced or the settled economic activities are available.

They are of 2 types:

1) Rural Settlements.

2) Urban settlements.

3 megacities

9 metrocities

53 millioncities

7935 towns.

1) Rural settlements(RS): - According to 2011 censes, India has 6,41,000 Rural habitations, which are housing around 68.84% of the total population.

RS are broadly divided into 4 types:-

a) Compact settlements: (CS)

These are the settlements where the structures or the dwellings are present in close associations. It is said that the structure are not having the breathing space are seen in the areas where agriculture is well-developed.

The number of villages and that of the hamlets if are equal, that area is said to be having CS's.

b) Semi compact settlements(SCS): - These are the settlements, which are build on spacious lands because of the non-fertile area in the surroundings. There will be the elbow-gap between the dwellings.

If the number of the villages equals to more than half of the hamlets, the area is said to have SCS's.

c) Hamleted settlement (HS)

These are the settlements which have a major village surrounded by a scattered group of dwellings. They will be recognized along with the main village though they have their individual names.

If the number of villages are equal to half the number of settlements, the area is said to have HS's.

d) Dispersed settlements (DS)

These are the settlements where there is a wide gap between 2 of the dwellings i.e., they are much scattered in nature.

These dwellings are deprived of neighbourhood, social interaction and communal inter-dependence.

If the number of villages are less than ½ the number of hamlets, the area is said to have DC's.

SIZES OF RURAL SETTLEMENTS: (SRS)

The SRS are based on the number of people residing in and may vary from less than 100 to more than 10,000 people.

According to 2011 censes, 3,961 villages are having a population of more than 10,000 people present in Malabar plains and north Indian plains.

In the areas of green revolution, the sizes of villages are more than 5,000 people because the land resource capability is very good.

In the NE, Telangana, Rayalseema and Vidharbha, where the resource base is very thin, the sizes of the villages are very small.

CRITERIA TO BE CALLED AS RURAL SETTLEMENTS:

Some of the conditions and criteria are been defined by census commissioner of 1991 and followed by 2001 and 2011 commissioners too.

Conditions are as follows:

1) Small size population.

2) Less population density i.e.,(<400 persons/sq.km)

3) More than 75% of the male working population engaged in agricultural activities.

4) The settlements should have more interpersonal relationships etc.,

SHAPES OF VILLAGES:

The shapes are very diversified in nature, but the most common shapes in India are as follows:-

1) Square or Rectangular: present in Malwa plateau and Narmada valley.

(seen in densely populated areas and very fertile lands where people do not waste for habilitation)

2) Linear shaped villages: present in Himalayas, konkan coast and Malabar coast.

3) Circular settlements: present in the Ganga-Yamuna Doab, peninsular India and the semi- desert areas of Rajasthan.

PHIRNIS- Cattle sheds in the centre of circular complex in Ganga-Yamuna Doab.

4) Semi-circular settlements: - present in the northern plains.

5) Triangular settlements: - present in the foot hills of the shiwalliks and western Ghats.

6) L and T shaped settlements: - present throughout India.

7) Amorphous settlements: - These are the shape-less settlements scattered throughout India.

8) Star shaped settlements: - These are the settlements developed in the cross-roads where several of the transportation arteries meet together. They are also called as “JUNCTION” settlements.

URBAN SETTLEMENTS

These are the settlements where the vertical growth dominates over the horizontal expansion.

Any of the settlement to be typified under urban settlement should follow certain criterias: -

1) All the areas with a corporation, a cantonment or a municipality are called urban settlements.

2) or They should satisfy the following criteria: -

a) A minimum population of 5,000.

b) Atleast 75% of male working population should be engaged in non-agricultural activities .

c) The settlements should have a density of atleast 400 persons/sq.kms.

d) Any settlement declared as urban by the census commissioner.

In India, we have “6- fold” classification. They are divided into 6 classes.

1) Class-1 population exceeding 1 lakh.

2) Class-2 population ranging between 50,000 to 99,999.

3) Class-3 population ranging between 20,000 to 49,999.

4) Class-4 population ranging between 10,000 to 19,999.

5) Class-5 population ranging between 5,000 to 9,999.

6) Class-6 population less than 5,000.

The class-1 are again differentiated based on population size into

1) City: 1 lakh to 1 million population.

2) Million cities: more than 1 million to 3 million.

3) Metros: more than 4 million.

4) Megas: more than 10 million.

URBAN PROBLEMS

1. Uneven growth.

2. multi functional apex

3. traffic problems

4. increasing slums

5. stress on civic aminities

6. unemployment

7. increased crime rate

8. waste or garbage disposal problem

9. increasing pollution levels.

Urban sprawl:

This is also known as the sub urban sprawl and it is a ‘disorganized

expansion' of an urban area and it is a multi faceted concept which includes outward spreading of the city and its suburbs into the outskirts i.e., into the rural areas where the house density is low. This is an automobile dependent development on the rural land where the land uses are having higher segregations like some of the areas will be specifically residential and the others are used as the store houses or the industrial centers. The various designs and the features present in the sprawl encourage the motor dependency. Some of the geographers see the sprawl to be only the amount of residential units in a given area i.e., the average number of habitations per acre but some others associate the sprawl with the decentralization, the discontinuity and the segregation of land uses and so forth. The decentralization involves the spread of the population without a well defined center. The discontinuity involves the leap frog development and the segregation involves the different activities separated by one another. The term urban sprawl generally has a negative connotation because it is an awkward spreading of the urban areas into the rural fringes. These are the areas where the health, the environment and the cultural issues associated are degrading. The residents of the sprawling neighborhood tend to emit more pollution per person and they are the more sufferers of the traffic fatalities. The sprawl is characterized by several land use patterns which occur in unison like

The single use zoning: This refers to a situation where large tracks of land are devoted to single use may be commercial (the malls or shopping complexes), residential (the gated communities), institutional parks and the industrial areas etc., which are separated and segregated from one another by many of the barriers.

Low density zoning: The sprawl consumes more land because only the horizontal growth is recommended (in traditional urban development, the vertical growth is recommended).

Car dependent communities: The areas of the urban sprawl are characterized as highly dependent on their own modes of transportation. In general now the well to do families who want to lead a peaceful and non polluted urban life are entering the sprawls where they are building up their palatial houses having more build up area

Conclusion: Though the urban sprawl is an awkward and disorganized spread, it is a necessary evil because it is providing the required expansion of the city leading the decongestion of the urban core. If the people living here are educated on the health and environmental issues, these spaces can

become the best places of habitations.

CONURBATION:

The term conurbation as a neologism was introduced by Patrick Geddes during 1915 in his book named ‘the cities of evolution’ (neologism- A new term introduced which may be in the process of entering the common usage but not been accepted by the main stream population). The term is derived from two of the latin words ‘con’ which means together and ‘urb’ which means city. The conurbation is a region comprising of a number of cities, towns and other urban areas which have merged to form one continuous developed area both in urbanization and industrialization. The merging is through the population growth and also because of the physical expansion of the city. It is a poly centric urban agglomeration having multiple jurisdictions. The availability of the motorized transportation and the new technologies of communications allows the cities to spread and agglomerate together so that they can be developed as single urban region or an area frequented for the work purpose and as a labor market. The NCR Delhi, a conurbation developed is due to the decongestion of the working areas from the poor cities with the development of the infrastructure. The Tokyo conurbation is the largest in the world. It has developed due to both the vertical and horizontal expansions. Some of the other conurbations present in the world are:

mid land ton (England),

ruhr, (germany), randstad,(Netherlands), newyork, (boston,USA), greater Tokyo and taiheiyo belt,Japan

NCR Delhi.

The metropolitan areas:

The concept was adopted in 1950 and it refers to a region consisting of densely populated urban core and the surrounding territories which are less populated but sharing the housing, infrastructure and the industries. In India, the census commission defined a metropolitan city to be an urban area having a population of over 4 millions. It may be an extended urban agglomeration. There are 9 metropolitan areas in our country.

NCR Delhi

Mumbai

Kolkata

Chennai

Bengaluru

Hyderabad

Ahmadabad

Pune

Surat

Metropolitan area is an area usually encompassing multiple jurisdictions and municipalities which have become the key economic and political regions. In these areas, the social structure, the economic activities and the political institutions have been changed or they are on the verge of changing. This area combines an urban agglomeration i.e., a continuous build up area with zones not necessarily urban in character but they are closely bonded to the centre by the employment or the other commercial activities. These outlying zones are sometimes referred to as the commuting zone or the commuting belt which generally extend beyond the urban agglomeration into the other political entities. Prior to 1990s these areas could not be developed because of the multiple political and municipal jurisdictions and also due to the lack of funds for the infrastructural developments. But after 90s the Asian development bank is funding the development of the transportation arteries and other communication activities. Due to this there is a spurt in the metropolitan areas of India.

The urban housing:

In India, there is a shortage of housing in both the qualitative and the quantitative aspects. The qualitative aspects include the potable water, sewerage and drainage facilities and the electricity etc., which are lacking in many of our housing units. The quantitative aspects include the number of housing units themselves. As per the recommendation of the working group on housing, there is a dearth of 80 million housing units in India of which 24.71 million housing units are in shortage in the urban areas.

Drawbacks for urban housing:

There are several drawbacks or constraints present though they are unique

but interlinked to one another. They include:

1. Paucity of land:

The major constraint for providing additional housing facilities is the lack of land because for every 1 million housing units around 6000 hectares of land is needed and this land either has to be taken from agricultural operated lands or to be reclaimed from the forest lands. Both of which are non advisable. The burgeoning population requires adequate food facilities for the population growth rate we require an additional 15 million hectares of agricultural land by 2015 and at present around 4 lakh hectares of agricultural land is diverted to non agricultural activities every year. Regarding the forest cover India is having around 23% of natural vegetation which has to be enhanced to 33% and hence there is no land available in India.

2. High cost of building materials:

The cost of cement, steel and wood etc., are increasing tremendously along with the sky rocketing of the land prices. The shortage of building materials is more pronounced in the rural areas. Hence they are not shifting their constructions to other than their traditional materials.

3. Shortage of finance:

There is no financial assistance available for the population in general and hence they are trying to adjust themselves within their budgets with the available accommodations

The government strategies:

1. The parliament has enacted the land ceiling and the regulation act in 1975. This prevents the concentration of urban lands in the hands of few there by preventing the speculation and profiteering by only a few.

2. The financial assistances are made available from the institutional sources like LIC, HUDCO, EPF and a host of other nationalized commercial banks. In 1988, the national housing bank was set up as a subsidiary of RBI.

3. The NBO (national building organization) was established in 1954 to take the research in low cost building designs. It is an apex organization and was restructured in 2006. The buildings material and technology promotion council has been set up for providing cheaper and durable technology transfer to the common people. The government is also supporting a number

of NGOs to train the artisans for the building purposes.

4. NHP(national houding policy), 1998:

It was endorsed in 1994 itself which gave a special emphasis for the rural needs like

- To eradicate the house less ness
- To improve the housing conditions.
- Involving the private participators in constructional activities.
- It has come up with social housing schemes.

This policy was replaced by national urban housing and habitat policy in 2007 keeping in view of the changing socio-economic parameters.

In 2005, the government has come up with basic services to the urban poor and the integrated housing and slum development program, which were incorporated into NUHHP. These two programs have come up to provide the adequate shelter with the holistic slum development. Under these programs, VAMBAY(valmiki ambedkar awaas yojana) and NSDP(national slum development program) were included.

In 2008, these programs were made as a part of Jawaharlal Nehru national urban renewal mission (JNNURM) and got as approval for construction of houses in 65 cities and 116 model villages. In 2009, the RAY (rajiv awaas yojana) was incorporated. All these policies intend to promote the sustainable development of habitat in our country.

SLUMS

These are the down city areas which are inhabited by the poor people. The growth of the slums is a peculiar problem of any of the urban settlement. These slums come up nearer to the industrial areas, transportation arteries, the ports, river banks, the drainage lines and around the wholesale markets. Around 25% of the population of the urban settlement are living in the slums and they are occupying a maximum extent of the metros and the million cities. Dharavi in Mumbai is the largest slum of Asia.

The living conditions:

The houses in the slums are mostly kacha may be made up of the mud, bricks, tins, bamboos and the tarpaulin sheets etc., The living area is not more than 100 sq.ft. The activities like cooking, bathing, sleeping etc., are

done in the open and for the general public conveniences there are common water taps, lavotaries and small open area for social gathering. The slums generally crop up in the low lying areas of the cities and mostly on government lands. Hence, they are prone to the floods, water logging conditions and many a times fire accidents. There is no proper drainage and the sewerage facilities available. They will be lacking the basic civil amenities. These lead to the occurrence and prevalence of the water borne diseases.

Social structure:

The social structure consists of the rural migrants who are coming from either the same community or the same area of origin. All the people will work at the same place and will be living together in these slums which are nearer to the centers of the cities or to the affluent and industrial areas because they can't afford the high transportation costs. The slum dwellers include the self employed persons, petty traders, the vendors, the hawkers and the house hold servants. As much of the youth is unemployed they resort to the petty crimes. Hence the slums are called as the breeding grounds of the criminals.

Government strategies:

Various governments have come up with many of the re-settlement schemes for the slum dwellers but these were not successful. This is because the re-settlement colonies which were built by the government were on the outskirts of the cities.

The slum removal is not a practical situation because one removal will be giving way for the other. Several governments tried but it has increased tension in those particular areas because these slums have turned to be the vote banks of the political parties. Keeping all these things in consideration, the governments have changed their policies. Now the focus is not on the slum removal but on the slum improvement. A working group which was set up during 8^{th} 5 year plan recommended for the introduction of the urban water supply and the sanitation scheme and also recommended that 75 % of the urban population to be provided with the basic civic amenities. In 1991, urban basic services for the poor (UBSP) was launched to improve the overall quality of the slum dwellers. For this the fund allocation was shared between the center and the state at a ratio of 60:40 respectively.

POPULATION

THE CAST GROUPS

India’s present cast system owes its origin to the chaturvarna system which divides the population into four classes based on the occupation of the people and the complexion of the skin. The classes are:

the Brahmins, a teaching class

the kshatriya, the warrior class.

Vysyas,The trading class.

Sudras, the artisan class.

The caste system was created for the decentralization of power and the work. Till the rigvedic period there was no caste system prevalent in India. Even the class system was porous. Before 1000B.C the caste system was introduced and by 600 B.C, the untouchability entered into the caste system. The Indian caste system is intensively hierarchal resulting in several social and economic problems. There are more than 3000 castes present in India.

SCs:

They have been the deprived, neglected and exploited lot of the Indian society since the introduction of the caste system. They constitute an important segment of the Indian population accounting for 16.2% of the total according to 2011 census. The decadal growth rate has been more than that of the general population. Karnataka has the largest number of castes included into the SCs-101. Orissa-93, T.N-76, Kerala-68, U.P-66, A.P, Maharashtra, Rajasthan and W.B each with 59 castes. Goa is having only 5 castes included. There are no SCs present in Nagaland, lakshadweeps and the Andaman & nicobar islands. The spatial distribution of the SCs is very uneven. Punjab is having the highest proportion of the SC population-28.9% of the total. H.P -24.7%, W.B-24%, U.P-21.1%, Haryana-19.3%.

The lowest of the %age is seen in Mizoram-0.03%, Meghalaya-0.5%, arunachal Pradesh-0.6%

In absolute terms, the population of SCs is maximum in U.P. it is around 35.14 millions. W.B-18.45 millions, bihar-13 millions, A.P-12.33, T.N-11.85. 79.8 % of them live in the rural areas.

STs:

They are believed to be the earliest settlers of the peninsular India and generally called as the Adivasis. A tribe is a homogenous and self contained

unit without any hierarchial discrimination. The study of STs suffer from serious anomalies like the Gonds are STs in A.P and M.P and are SCs in U.P. The STs constitute around 8.2% of the total population. Their population recorded a higher growth rate because of 2 reasons.

1. Rapid natural growth

2. Additions in to the list of STs

Their distribution is different from that of STs because they have a tendency to concentrate in remote and less hospitable areas. There is a wide variation in the state level distribution.

Lakshadweep-94.6%, Mizoram-94.19%, Nagaland-88.98%, Meghalaya-86.43%, arunachal Pradesh-64.63%.

The lowest %age is seen in goa-0.04% and Andaman&nicobar- 8.3%, Pondicherry, Delhi, Haryana, Punjab and Chandigarh do not have ST population.

Major tribes of India:

Santhals(6.5 million people):

They are concentrated in Tripura, bihar, Jharkhand, WB and Orissa.

Gonds (4 million):

They are scattered in M.P, AP, Chhattisgarh, Maharashtra, gujrat, Bihar, kharkhand, Orissa, WB and Karnataka.

Bhils:

M.P, A.P, Chhattisgarh, Gujarat, Karnataka, Rajasthan and Tripura.

Minas:

99% of the minas are concentrated in Rajasthan.

Various other tribes present in India are: Oraons, Mundas, khonds, chenchus, yerukas, todas, nagas, andamans, nicobars etc.,

Religious composition:

India is the birth place of 4 major religious namely Hinduism, Buddhism,

Jainism, Sikhism. But it has embraced other world religions.

Hindus:

They account for 80.5% of the total population of India and 14% of the world population. It is the 3rd largest religion in the world. They are outnumbered by the muslim in J&K and Lakshadweep, by Sikhs in Punjab, by Christians in Meghalaya, Mizoram and Nagaland.

Muslims:

They account for 13.4% of total population of our country. Their absolute numbers and the population growth rate is very high when compared to other religions. They are mostly concentrated in urban centers.

Christians:

They account for 2.3% of total population. Numerically Kerala dominates followed by A.P and the Christian population is an increase in the tribal areas.

Sikhs:

They account for 1.9% of total population. They are the most migratory people of our country and more than 90% are concentrated in Punjab alone.

Buddhism: 0.8%

Jains: 0.4%

RACE

Race is a biological grouping within the human species with genetically transmitted differences. In common usage, varieties of ways are there for pointing out the racial classification but none of them are correct from the scientific point of view. The origin of race is a subject of controversy. The classification is based on the possession of certain combination of fixed and inherited trades like skin colour, eye colour, form and colour of hair, shape of nose, protrusion of face, the stature and shape of the head etc.,

Races in India:

There is no strict line of demarcation between the races and there is a wide range of diversities in India because India is a melting pot of various races from time immemorial. Several people have given the racial classification of

India. But, three of them are prominent like

Risley -he 1st attempted the racial classification in India in 1886-88.

Guha- he has given his classification in 1931

Hutten- he gave his classification in the early 20th century.

Guha's classification: His classification is based on the occupants and the source region from where they have come and he has classified the Indian races into 6 types.

1. The negroids or Negritos:

These are the earliest occupants of India who came from the African continent.

The morphological features: They are short statured. The skin colour varies from dark brown to black. The hair is wooly or kinky in nature. Bulbous forehead. Broad, short, flat nose and slightly protruding jaws. The lips are thick and averted. Ex: zarwas, nicobaris, kadars of annamalais, uralis of neelagiris, puliyans of palani hills, angami nagas of Assam etc.,

2. Proto australoids:

These are the people who have come to India after the negroids from the east Mediterranean area i.e., Palestine.

The morphological features are same as that of the negroids except the dark brown colour and no wooly hair. Ex: bhils, kols, badagas, mundas, kurumbas, chenchus, yerukas etc.,

3. The mangoloids:

Most of the people believe that the china and mangolia are to be the homelands of these people.

Morphological features: Round and broad head, face with high cheek bones, long flat nose, no facial or bodily hair and the eyes with epicanthic fold. They are of two types.

Tibeto mangoloids:

These are broad headed people with tall stature and most of them are settled

in Ladakh and Sikkim areas. Ex: Ladakhis, kannets of lahul & lepchas.

Paleo-mongoloids:

They are both broad and long headed and mostly settled in the north eastern region. Ex: sema nagas & limpus of Nepal.

4. Mediterraneans:

They had come from the SW Asia and are the architects of the IVC and are divided into 3 subtypes.

a. Paleo-mediterraneans: they are medium statured people, dark skinned with long heads. Ex: tamil Brahmins, telugu Brahmins, nayars of kochin.

b. Mediterraneans: they are the dominant people of the ganga plains. Ex: the Brahmins of U.P, W.B, and the Marathas of Maharashtra.

c. Oriental mediterrraneans: they are medium statured, fair skinned and the noses are long and convex. These people had come from Arabian Peninsula. Ex: Punjabi chatris, pathans and the people living in lower shivaliks.

- ➢ Dravidians: Accoriding to Risley, they are the most primitive of the Indian people occupying the oldest geological formations of the country extending between the aravallis in the west, to the rajmahals in the east and the kanya kumari in the south.

5. Caucasoids/Brachycephals:

These are the broad headed people who have entered India from germany & adjacent regions and are divided into 3 major groups based on the 3 routes followed by them to enter India.

a. Alphinoids: These are ones who have entered India through Baluchistan, sindh, gujrat, Maharashtra and Karnataka. Ex: coorg

b. Dinarics: They entered India via Kashmir into the ganga valley and into its deltas. Ex: rajputs

c. Armenoids: They had taken the 3rd route via Kashmir they entered Nepal and then into the indo gangetic plains. Ex: kayasthas of Bengal.

All caucosoids are well built, fair skinned, tall with broad shoulders having ridged noses.

6. Nordics:

They constitute the last wave of migrants into India from the central Asia and Russian steppes. They are long headed, strong built, fair skinned, tall stature and high bridged nose. Ex: kashmiris, rajasthanis, Punjabis etc.,

Population growth since 1901:

There are three significant demographic divides in India when the population growth is considered. They are the years of 1921, 1951 and 1981 and they have divided our population growth into 4 periods.

Pre 1921 period:

This period is also called as the stationary period where both the birth rates and death rates were high and fluctuating and they counterbalanced each other. The society was illiterate and was not having the access to the medical and other sanitation facilities.

1921-51 period:

This is called as the ‘period of steady population growth rate’. In this period the mortality rates started showing the downward trend because of the increased and improvement of medical and sanitation facilities. The crude death rate which was 47.2 per thousand in between 1911 and 1921 have declined to 27.4 per thousand by 1941-51.

1951-81 period:

This is called as the period of “population explosion”. Because the death rates have been completely lowered due to the intrusion of medical facilities into the rural interiors and the birth rates remained the same because of the orthodox psychology of Indian people. This caused the natural growth to rise steeply and within the 30 years, there was an increase of 89.2% in the Indian population has been seen (1951-361.09 million; 1981-683.3 million)

Post 1981 period:

This period is called as the “declining population growth period” because both the birth rates and the death rates have shown the declining trend. Thus 1981 signifies the initiation of new era in the Indian demographic history and now the country has reached to a take-off stage in its demographic evolution. But still, we are far away from our goal of population stabilization or population

control with a population growth rate of 1.1%

Population policies:

India was one of the pioneering countries to introduce the population policies. The 1st national population policy was formulated in 1951. This had a piece meal approach or the cafeteria approach because this policy was a voluntary in nature where it has encouraged the contraceptives and the sterilization methods (nirodh, vasectomy and tubectomy).

1981-population policy:

This was called the “integrated population policy”. In this policy, the family planning program was integrated with the education, basic health services the provision of nutrition to the expectant mother and the infant. But this policy too has not given the required results. In 1998 M.S.Swaminathan Commission was appointed to look into the the unprecedented population growth. He opined that the basic lacuna of our population policies was mistargeting i.e., the mother was targeting & in India, among most of the societies, the mother is not not the decision maker. So, he recommended a broad based target approach, which says to persuade the family members into the population policies & the empowerment of women.

2000 Population policy:

The main aim of the population policy is to achieve the ‘population stabilization by 2020” with an annual population growth rate of 1.1%, for this , it recommended for the following:

1. To have the “region specific policies” with “tailor made approach” and advocated two models:

a)Ernakulam Model: which says that focus on literacy and education will be the best controseptive because the reproductive age period will be shortened if the younger generations are involved in the career building activities.

b) Karimnagar model: it says to focus on health and not education. Because the karimnagar has achieved a distinction of several growth parameters in 1990 itself like the population growth rate of 0.8%, Infant mortality rate of 20/1000 and the couple protecton rate of 90% with more than 60%of vasectomy cases.

*It also recommended for the provision of incentives and disincentives to the

good performing local bodies.

*The small family norm to be enlisted for the beneficiaries.

*The maharastra govt.has taken this approach for all the govt. benefits.The family with more than 2 kids has been deleted from the list of beneficiaries

*AP and Karnataka governments have taken one small family norm for conresting the local body elections.

THE ROLE OF NGO'S:

It recommended involving the NGO's in planning and implementing of the family planning programs.

*It said, the population programme should be taken as a specific project. i.e., the time boundedness and like a movement.

*It recommended for the devolution of the financial parks to the the district level authorities directly from the centre.

DISTRIBUTION AND DENSITY OF POPULATION:

The most important aspect of Indian population is its uneven distribution. On one hand the population is highly concentrated in some pockets like the urbanized and industrialized areas and also in the areas of high agricultural productivities and on the other hand, they are virtually demographic deserts like the mountain highs ,arid lands, the thickly forested areas alomg with some remote corners of the country.

SOME GEOGRAPHIC FACTORS AFFECTING THE DISTRIBITION AND DENSITY:

1) Terrain: It is the most potent factor which increases the conc. and growth of population .Eg: the mountains have no transportation , no industrialization and no other economic activities. This tend to discourage the population concentration and hence though the himalays account for 13% of the India's land area they house only 1-2% of the total population whereas the indo gangetic plains, which cover less than $1/4^{th}$ of the land but houses more than 50% of the total population.

2) Climate: It is as important as the terrain. The population map of India follows the rainfall map. A moderate climate favours the population concentration. Since India is a tropical country, the temp does not play an

important role as that of the rainfall.

3) Soil: This determines the density specially in the agrarian country like India. The fertile soils support higher population densities while the infertile soils lead to lower densities. However, the new technology in the agricultural field may change the future population scenario to some extent. Population is always resource found in nature and the distribution is dynamic which dosen't take place over night but takes decades.

Density at macro levels: The high density population having more than 100 persons per sq. km are seen in the indo-gangetic plains, Assam valley and the coastal area.

The moderate density population is where the density ranges from 10-100 persons/km^2 seen in eastern rajastan, Chambal, Khatiwar, Son-mahanandi basin, Krishna-Godavari-Wardha basin, Kaveri basin, Manipur valley.,

The low density areas are those having 5-10 persons/km^2 and this includes the area of rest of peninsula.

Very low density areas are those having less than 5persons/km^2 and include northern Gujarat, Western rajastan, entire north-eastern, Himalayas except the Kashmir valley.

Density at micro levels: The very high density population areas are present in the form of small dots scattered throughout i.e., in the urban centers of our country where the density is more than 500 persons/km^2 . Extremely low density population areas are also in the form of isolated dots like the Baster of Chhattisgarh, Ladakh of Jammu and kashmir, Chamba of himachal Pradesh, Barmer of rajastan, Tuesang of Nagaland-mishmi hills of arunachal Pradesh, the hill district of Meghalaya and the nicobars of Andaman and Nicobar.

Population problems in India:

India accounts for only 2.4% of the world's geographical area but houses 17.5% of the world population. This leads to higher population densities causing stress on the natural resources. Every year there is an addition of population equivalent to the Australian population. The larger population growth rates in India are due to the presense of largee base population. The cumulative population growth rate is at a very high level compared to the cumulative food growth rates. The over exploitation of the natural resourses

is causing environmental degradation and increasing the population level.

The major problem of our population is the declining sex ratio.

Because of increased population there is unemployment leading to migrations and increase in the slums and poverty levels in cities. When unemployment and poverty are combined, they result in the increased crime rates.

‘TRANSPORTATION’

It is a system in which the passengers and goods are carried from one place to another.

The transportation routes are the basic economic arteries of any country. The amount of traffic in motion is the measure of the country’s progress.

The transportation system includes:-

1. The land transportation (roadways, railways, pipelines).

2. water transportation (inland, oceanic routes).

3. Air transportation (domestic and international).

1. ROADWAYS: The romans are considered to be the earliest, road builders. They are easy to construct and maintain. They acts as feeders to all other mode of transportation and give access to the door-to-door delivery.

The evidences of the paved roads are seen in the ruins of Harappa and Mohenjadaro which are about 5000 year old. The emperors like Chandragupta and Ashoka had made efforts to construct roads in India but the real progress of the roads in India was started with Mughals and Shershahsuri in particular, who built the road from Dhaka (Sonargoan) to Lahore (Peshwar) connecting Delhi, it is called as the ‘sher shah suri margh’ or the ‘grand trunk road’.

A serious attempt was made by Britishers in 1943 for the expansion of the road network in India by drawing the Nagpur plan but the plan could not be implemented because of the princely states. At last, this was achieved in 1961, after independence. In 1961, the 20 years road plan was given and its main objective was to increase the road density to 32 km/100km^2 . The roads in India are classified into 4 major types according to Nagpur plan.

a) The national highways [NH]: At present, the national highways account for a total length of 70,934 and 40,000km under implementation. That will be around 2.02% of the total road network of India. These were constructed and maintained earlier by central public work department, (cpwd). There are large no. of NH's present in India numbering to 235 and having several extensions. But at present the ministry of roads and buildings is carrying out the development and maintainence of NH work through 3 of its agencies:-

1. The national highway authority of India.

2. State public work department.

3. Border road organization (BRO)

The NHAI implemented NHDP (national highway development project) program and completed several works in 7 phases.

NHDP-1:

This includes the construction of the golden quadrilateral or the swarna chaturpatha for connecting the then 4 metros of India - Delhi, Mumbai, Kolkata & Chennai. Under this they constructed a route length of 5846 km.

NHDP-2:

It includes the construction of the N-S & E-W corridors connecting Srinagar to kanyakumari & porbandar to silcher (Assam), it has been extended for connecting 10 major parts. This phase had constructed 7,300 km of new road & 831 km of the existing road was up-graded.

NHDP-3:

Under this 12,109 km of highway was 4 laned connecting the state capitals with the important tourist places & places of economic importance.

NHDP-4:

This phase included the two laning of 20,000km of NH with pavements.

NHDP-5:

This was the program intended to increase the width of existing 4 lane NHs into the 6 laned ones on design build, operate & transfer basis. This also included 5,700km of the golden quadrilateral.

NHDP-6:

Under this phase 1000km of express highways have been developed connecting the major commercial and industrial township.

NHDP-7:

This program is for the improvement of city roads by constructing ring roads, flyovers and the bypassed roads in the selected stretches. Under the NHDP program the total road up gradation done was 45,000km.

SARDPNER (special accelerated road development program for north eastern region):

This was initiated specially for the improvement of 3228 km. of the national highways and 4388 km of the state highways for ensuring the road connectivity of all the district headquarters with all the state capitals in the entire north eastern region. The breakup of the national highways in terms of width is as follows

Single laned: account for 18350 km which is around 26% of the total.

Double laned: for 36031 km. or 51% of the total.

4, 6 or 8 laned: 16553 km. or for 23% of the total

The road ways are called differently in different countries. In germany, auto bahns, in france-auto routes, in Italy-auto strades, England-motor ways and the rest highways.

RAILWAYS

They constitute the backbone of the surface transportation in India. 1st railway system was introduced in England in 1806 & 07 where the coaches were dragged by the horses. It was between Swansea to mumbles and the 1st railways by the steam engines were opened up for the public in 1825 between the Stockton to darlington. In India, the 1st railway line was open for the public on the 16th april, 1853 between Bombay and thane for 34 km. This was extended to kalian by 1st may, 1854 and till pune by 14th july, 1858. Meanwhile, in the eastern sector also the construction was going on and it was opened for public on 15th august, 1854 between howrah and hughli for 37 km. and by 1866, there was a link between the howrah and delhi. During the time of independence, India had a railway root length of 65,217 km. Of this 10,523 km went to Pakistan and at present India is having a root length

of 64,360 km. with more than 7,500 stations and it is the 4th largest system in the world after USA, Russia, china but in carrying passenger capacity wise, India tops the list. During 2011- 12, the total passengers carried by Indian railways has neared 7 billions.

Factors affecting the railways:

1. The geographical factors: the plains and level lands with higher population densities and richer agricultural productivities are more favourable for the growth of railways. In the northern plains, the density of railway network is high. It is because of the availability of the plain lands. In the peninsula, the density is moderate. It is because of the plateau and hilly terrain. In the Himalayas, the rail density is equivalent to nil because of the mountaneous terrain. Till recently, the Himalayas had only 3 narrow gauge lines like the kalka –shimla, pathankhot-khangra, siliguri-darjeeling and now a broad guage line is open between the Jammu and baramulla for 345km.

2. Economic factors: Generally the railways are developed in more economically advanced areas conversely bringing the economic prosperity to the areas i.e., the railways and the economic prosperity are complementary to each other.

3. Political and administrative factors: The proliferation of railways has taken place in India due to the legacy of the Britishers. The main aim of the railways was to facilitate the imports and exports and also for the speedy movement of their troops and hence the railways were developed only from the port cities to the hinter lands(land served by the ports).

So, the railways were developed in India by the Britishers for their administrative feasibility.

Railway zones:

At the time of independence, we had 42 different railway systems which were administered by 37 different companies. After the independence, the railway board plan was constituted in 1950 and according to it, all the railway systems of India were grouped into 6 zones, in between 14th April 1951 and 4th april, 1952 and on 2nd October, 1966. 3 more zones were mooted out and India had 9 railway zones till 1996. They are:

Central railways-victoria terminus, Mumbai

Northern railways-Delhi

Eastern railways-kolkata

Southern railways-chennai

Western railways-bombay central

North eastern railways-ghorakpur

North eastern frontier railways-malegaon-gauhati

South eastern railways-kolkata

South central railways-secunderabad.

On july 15th, 1996, 6 more zones were mooted out.

North central railways-allahabad

North western railways-jaipur

South western railways-hubli

East central railways-hazipur

West central railways-jabal pur

East coast railways-bhuvaneswar.

In 2003,

South eastern central railways was added – gilaspur (head quarters)

In 2010,

Kolkata metro became the 17th zone and in 2011, Delhi metro has become the 18th zone. There is a demand for several zones at present.

Qualitative improvements:

At present, we have a route length of 64,360 kms and a track length of 1, 11,945 kms.

Gauge:

In India, we have 3 gauge systems:

a. Broad gauge:

in this, the distance between two of the rails/tracks is 1.675 m/5.6 ft. The route length of broad gauge in India is about 52,845 kms which is 82.1% of the total and the track length is of 97,010kms, which is 86.6% of the total. The broad gauge is useful for efficient and faster transportation and it can be laid only on the plain lands.

b. Meter -gauge:

the distance between 2 of the rails is 1 m. and it is having a track length of 13,412 kms. which is 20% of the total length and a route length of 9,000 kms i.e., around 13.9% of the total. The Indian government is trying to do away with the meter gauge system.

c. Narrow gauge:

we have 2 different narrow gauges present in India. They account:

0.762m

0.610m

This narrow gauge is good for mountainous tracks where efficient manuring can be easily done by this gauge.

For the higher speeds and larger capacities the railways are gearing up for the uni-gauge system in India.

Rolling stock:

The manufacturing and construction of the locomotives i.e., engines and the coaches are included under the rolling stock. Initially we had the steam locos which were run by using the energy source from coal. By the introduction of diesel traction, the functionality of our railways got improved by 30% and by introducing the electric traction, there is an improvement by 100%.

At present, India is considering even for the introduction of maglev traction (i.e., magnetic levitation) which will enhance the functionality of railways by nearly 100-150%. The feasibility studies for the introduction of maglev traction had also been completed.

- The diesel locomotives are manufactured at Varanasi.

- Electrical locomotives-chittaranjan (WB)
- Railway wheel factory – Bangalore
- Railway coach factory -kapurtala, Punjab.
- Integral coach factory-perumbur, Chennai.
- Diesel locomodernisation works-patiyala, Punjab.
- Central organization for railway electrification-allahabad.

In order to keep in pace with the technological changes, the Indian railways has entered into an agreements with M/s, general motors, USA for the transfer of technologically to manufacture 4,000 HP, the state of art, ACDC micro processor controlled fuel efficient locomotives, which are being produced now at the diesel locoworks, Varanasi. The railways has also collaborated with M/s ABB company of Germany for manufacturing 6,000hp. 3 phased electric locomotives at chittaranjan loco works.

Since 1924-25, there is a separate budget for the railways. In the 11^{th} 5 year plan, a dedicated fright corridor covering 2,760 kms was announced. The eastern corridor runs from Ludhiana (Punjab) to sonenagar of Orissa. The western corridor runs from navasheva (Mumbai) to dadri (Haryana).

Track electrification:

The electrification was started in 1925 for a mere 16kms from Bombay to kurla and bandra.

Now around 41% of the total track and 28% of the route length has been electrified.

Infrastructural development:

This includes the automatic signals, the stronger rails, the concrete sleepers etc., with the mobile and STD facilities.

The government has also introduced some of the super fast express trains like rajdhani, shatabdi, garib radh, duranthu etc.,

We are also planning to introduce the solar trains for which government is talking with the French authorities for the transfer of technology.

Recently, railways also conducted the ‘anti-collision device test’.

Toy trains of India:

1. Darjeeling-siliguri got the UNESCO heritage status.

2. Kangra-patanpot
3. Simla-kalka
4. Neral-matheran
5. Nilgiris-ootakamund(ooty)

The tourism trains of India:

1. Palace on wheels-Rajasthan.
2. Royal orient express-Gujarat&Rajasthan.
3. Deccan odissi-maharashtra
4. Golden chariot-bangalore&mysore.

AIRWAYS

It is the forest mode of transportation which led to the drastic shrinking of world.

The air transportation in India, made a humble beginning in 1911 for 10 kms. between Allahabad and naine. The Indian national airways was formed 1933 by tatas.

In 1941, we have assembled the 1st aircraft in India,

In 1953, the nationalization of airways occurred by air corporation act of 1953 and 2 corporations were formed.

1. Air India

2. Indian airlines

At present India is having the bilateral air services with 103 countries.

a. Air India:

This is for international services and got enhanced specially after the gulf routes were established.

b. Indian airlines:

this handles the domestic traffic, cargo and mail services within India and also provide passenger services to 12 of the neighbouring countries like pak, Nepal, Bangladesh, Maldives, srilanka, Malaysia, Thailand, Singapore, Kuwait, UAE, oman, Myanmar.

Indian air lines hass been re-christened as “the Indian” with the logo of the

“wheel of progress”.

c. Vayudooth services:

this was setup in 1981 to augment the air transportation in our country by providing the links to the remote and inaccessible areas of the country. It got merged with India airlines in 1992-93.

d. Pavan hans ltd.,:

This was established in 1985, this provides the helicopter services to petroleum sector like ONGC, OIL and ENRON etc., and to the NTPCs along with the GAIL & BSF (border security forces).

There are certain states and union governments like Punjab, M.P, Chhattisgarh, north eastern states, J&K (Ladakh) & chandigarh etc., avails the services of pavan hans.

e. Private sector:

The private taxies started their services in 1990 and in march 1994, the air corporation act of 1953 got repealed which broke the monopoly of Indian government and the private pliars got the scheduled air line status.

At present 37 private pliars are present in India.

Airports:

The national airport authority & international airport authority were merged on 1st april, 1995 to form the airport authority of India(AAI) with two divisions:

1. International air division

2. National air division

The private participation is required for the infrastructural enhancements to be in the competition.

There are 12 international airports, 35 major aerodromes, 22 intermediate ones and 43 minor aerodromes present. On the whole, there are more than 300 sites present in India which are having the feasibility for the flight landings.

International airports:

Amritsar, Delhi, Ahmadabad, Gauhati, Kolkata, Mumbai, Hyderabad, Goa, Chennai, Bangalore, Cochin, Trivandrum.

Of these, 6 are privatized ones.

1. Ahmadabad (NRIs, state government & government of India)
2. Cochin (NRIs and the government of India)
3. Bangalore(GVK consortium)
4. Mumbai (GVK consortium)
5. Delhi (GMR consortium)
6. Hyderabad (GMR consortium)

The recently opened terminal in Delhi is the 3rd largest passenger terminal which can hold 78 planes at a time, in Asia, after Dubai & Beijing.

The airport authority of India has consultancy services in Afghanistan, Libya, Yemen, Maldives, Algeria and Nauru.

WATER WAYS

The water ways are of 2 types. :

1. The inland water ways

2. The oceanic or the sea routes.

The inland water ways were the chief modes of transportation before the advent of the railways. These are the cheapest means of transportation for heavy and bulky materials having least cost. This is fuel efficient and eco-friendly but at present they are accounting for only 1% of the total transportation. The total navigable water ways in India account for 14,500 km. and they comprise of the rivers, canals, creeks and the back waters etc., Of these 3,700km. are navigable by the mechanized boats (the total navigable canals account for 4,300km of which 900 km are navigable by the mechanized boats.) still the inland water transportation are greatly underutilized in India. On 27th Oct, 1986, the IWAI (inland water ways authority of India) has been constituted. It undertakes the projects for the development for infrastructure and the maintenance of the inland water transportations. The government has identified 10 important water ways in the country and some of them are given the status of the national water ways. There are 5 national water ways present in India. They are:

1. Allahabad – haldia water way on R.Ganga

2. Sadia – dubri water way on R.Brahmaputra
3. Kollam – kottapuram on R.Periyar
4. Kakinada – puducherry (it was bhadrachalam – Rajahmundry previously) on R.Godavari
5. The mangalgodi – thalcher – paradweep on R.Mahanadi.

The 6th water way is proposed between lakhipur and bhanga on R.Barak.

Ports:

India had a glorious past w.r.t shipping which flourished in the ancient times. The Indian ships and boats were been sailing from the past 4000 years but got a set back during and with the arrival of the European companies. The recent discoveries at lothal, a port city in Gujarat gives the evidence of the ports during the Harappa and Mohenjo-Daro period. The shipping in India has made a considerable progress in the post independent era. There are 13 major and 200 medium and minor ports present in India. The major ports handle about 97% of the foreign trade in terms of volume and 77% in terms of value. The sea routes were present before the Christian era and a considerable expansion took place in the gupta empire. The cholas and chalukyas swept the south east Asian seas and spread the hinduistic way of life during their reign.

The ports on the east coast:

Tuticorin: this port handles coal, sugar, food grains, edible oils and petrol etc.,

Ennore: this is the medium port upgraded into the major port in 2010 for decongesting the Chennai port.

Chennai: This is the oldest artificial harbor and handles fertilizers, petrol, iron and steel and the food grains.

Visakhapatnam: This is the deepest land locked and protected port. It handles the iron ore, fertilizers, granite etc.,

Paradweep: This port handles the iron ore and the coal. Japan has constructed an exclusive oil jetty here.

Kolkata, haldia: Kolkata is a riverine port on R.hughli which is 128 km inland. The haldia port is developed to decongest the Kolkata port. It is 105 km downstream of Kolkata.

Port blair: This is the medium port recently upgraded to the major port in

October 2011.

The ports on the western coast:

Mumbai: It is a natural harbor and the port was constructed in 1774.

Nhavasheva or the Jawaharlal Nehru port: It is the recently developed port with most modern facilities, to decongest the Mumbai port.

Kandla: After the opening of the Suez Canal, there was heavy burden on the Mumbai port. To release the pressure, the kandla port was developed.

Marmagoa: This port handles the iron ore and coal.

New mangalore: This port handles the iron ore from Kudremukh mines along with tea, coffee, rubber and spices.

Cochi: It is a natural harbor with back water bays and it handles the artifacts, spices and rubber. This is the 1st port developed in the medieval India for the trading of the spices.

Factors effecting inland waterways:

The rivers and canals should have a regular flow of water i.e., they should be perennial in nature.

The presence of waterfalls, cataracts and sharp bends hinders the water ways. The inland water ways require a smooth and steady flow of water without curvatures.

The silting of the river bed reduces the depth of the river.

The diversion of water for the irrigation facilities.

There is no efficient demand to make the waterways to be economically viable. Hence, the government is lethargic in improving the waterways.

Facilities:

Cochin ship yard ltd., : This is the largest yard of the country came into existence in 1972. It builds tankers, bulk carriers, port crafts and vessels etc.,

Garden reach ship builders and engineers ltd., Kolkata: Came up in 1934 and got nationalized in 1960. It builds the war ships with high technology.

Hindustan ship yard ltd., Visakhapatnam: Came up in 1949 and got nationalized in 1952 and in 1962, it became a public sector company and in 2012 it went into the hands of navy. It is the only shipyard in India to receive the certification for international standard for quality assurance. This ship yard has put a mark among the builders of the nuclear submarines.

Hughli dock and port engineers ltd., Kolkata: It has become a PSU in 1984 having 2 working units each at salkai and nazir ganj. At present 100% FDI is allowed in automatic route for the construction and maintenance of ports and harbors in India.

Pipelines:

These are the most convenient, efficient and economical modes for transporting the liquids and gases. Even the solids can be transported after converting them into the slurry. The pipeline transportation is a new development in India. It got prominence because they are associated with the crude and natural gas. The pipeline like structures were seen in the ruins of the Harappa and Mohenjo-Daro. The 1st pipeline in India was laid in Assom for transporting the crude oil from naharkatiya to nunmati in 1962. This was extended till barauni in 1964 and by 1966 it got extended till Kanpur and haldia. The another important pipeline runs from salaya in Gujarat supplying crude to Mathura refinery. This has been extended to jalandhar via panipat. The important natural gas pipeline present in India is HBJ pipeline that starts from hazira in Maharashtra to jagdeeshpur in U.P via bijapur of M.P. this gas pipeline supplies gas to a number of fertilizer plants like sawaimadhopur in Rajasthan, aonla and shahjahanpur in U.P and the domestic gas to Delhi. GAIL is the largest company in India for marketing the natural gas through the pipeline network of more than 5000 km.

Some of the petroleum pipelines have been planned and some of them are nearing the completion. They are:

1. Virangram near kandla to bhatinda in Punjab serving kota, jodhpur and panipat.
2. From the Kanpur of U.P to bina of M.P (which is having the only joint sector oil refinery)
3. Chennai to mangalore
4. Visakhapatnam to Vijayawada.
5. Mumbai to manmad.

The reliance industries has also set up the gas pipelines connecting KG basin

to Ahmadabad serving Vijayawada, Khammam, Warangal, Hyderabad etc.,

TOURISM:

Travelling to relatively undisturbed places for admiring the beauty, enjoying the scenario, the flora and fauna or for enjoying its cultural and religious aspect is called tourism. It is an important socio economic activity which has attained the status of an industry. It generates huge foreign exchange and boost the local made handicrafts and the cultural activities. The 1st tourism was the pilgrimage but now its scope has widened to the bottom of the sea into the space. It provides employment opportunities which are still awaited for exploitation. The hotel segment forms a key segment in the tourism industry and they are classified under the star systems. Depending on the services provided and the hospitality given, the hotels are put under 7 different categories of star systems. In the recent past, the new heritage hotels were also introduced into this sector. In India, we require a large number of budget hotels to accommodate Indian middle class tourists.

Places of tourist interest:

They may be of varied varieties may be from archaeological, historical, pilgrimage to the sanctuaries, national parks, hill stations, beaches etc.,

The Himalayas:

They are the main tourist destinations of India. It is because of the lofty peaks, snow clad mountain ranges, lush green valleys and the serene atmosphere with virgin locales. The adventure tourism is gaining importance and drawing the crowds to the Himalayas (hiking, trekking, mountaineering and rafting). The tourist destinations present in the Himalayas are hill stations including shimla, almora, Dalhousie, Darjeeling, mussoorie, pahelgaon, Srinagar, gulmarg etc.,

The pilgrimage destinations: Amarnath, vaishnodevi, gangotri, yamunotri etc., The entire ranges are dotted by many of the sanctified shrines.

The indo-gangetic plains:

The plains are known for the archeological and the historical destinations. Jaisalmer-jodhpur-bikaner is called as desert triangle of tourism. Delhi-agra-jaipur is known as the golden triangle of tourism. There are several religious destinations present in the plains like Amritsar, kurukshetra,

Mathura, brindavan, prayag, Varanasi etc.,

The peninsular India:

It offers a wide variety of tourist destinations ranging from the dry deserts of Rajasthan to the evergreen lushy forests of Western Ghats and from the hill stations of the central peninsular India to the beaches of the coastal plains.

The islands:

The islands of Andaman & nicobar and the Lakshadweep are the tourist attractions mainly for the sea locales and for the deep sea diving etc., The SCUBA (self contained underwater breathing apparatus) diving is gaining popularity among the Indian tourists.