Geography of India

Unit II: Climate, Vegetation and Soil – Factors affecting climate – Seasons of India – Impact of Monsoon – Natural Vegetation: Types – Soils: Types

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Introduction

- India's climate closely resembles the climate that of a tropical country although its northern part (north of tropic of cancer) is situated in the temperate belt.
- Indian subcontinent is separated from the rest of Asia by the lofty Himalayan ranges which block the cold air masses moving southwards from Central Asia.
- As a result, during winters, the northern half of India is warmer by 3°C to 8°C than other areas located on same latitudes.
- During summer, due to over the head position of the sun, the climate in the southern parts resemble equatorial dry climate.
- The north Indian plains are under the influence of hot dry wind called 'loo' blowing from the Thar, Baloch and Iranian Deserts, increasing the temperatures to a level comparable to that of the southern parts of the country.
- Thus the whole of India, south of the Himalayas can be climatically treated as a tropical country.
- The seasonal reversal of winds in Arabian Sea and Bay of Bengal give India a typical tropical monsoon climate.
- So Indian climate, to be precise, is tropical monsoon type (a distinct wet and dry climate) rather than just a tropical or half temperate climate.

- India has high Regional Climatic Diversity because of its topographical diversity (location, altitude, distance from sea and relief).
- The climate in most of the regions is characterized by **distinct wet and dry seasons**. Some places like Thar desert, Ladakh have no wet season.
- Mean annual rainfall varies substantially from region to region. **Mawsynram and Cherrapunji** in Meghalaya receives around 1,000 cm of annual rainfall while at Jaisalmer the annual rainfall rarely exceeds 12 cm.
- The Ganga delta and the coastal plains of Odisha see intense rainfall in July and August while the Coromandel Coast goes dry during these months.
- Places like Goa, Hyderabad and Patna receive south-west monsoon rains by the first quarter of June while the rains are awaited till early July at places in Northwest India.
- Diurnal and annual temperature ranges are substantial.
- Highest diurnal temperature ranges occur in the Thar desert and the highest annual temperature ranges are recorded in the Himalayan regions.
- Both diurnal and mean annual temperature ranges are least in coastal regions.
- In December, the temperature may dip to – 40°C at some places in J&K while in many coastal regions average temperature is 20-25°C.
- Winters are moderately cold in most of the regions while the summers are extremely hot.
- Himalayan regions experience brutal winters while the summers are moderate.

Factors affecting Climate

- Latitudinal location
- Distance from the Sea
- The Himalayas
- Physiography
- Monsoon Winds
- Upper Air Circulation
- El Nino and La Nina
- Tropical Cyclones and Western Disturbances

Latitudinal location

- Indian climate resembles the climate of a tropical country.
- The mainland of India extends between **8°N to 37°N.**
- Areas south of the Tropic of Cancer are in tropics and hence receive high solar insolation. The summer temperatures are extreme and winters temperatures are moderate in most of the regions.
- The northern parts on the other hand lie in the warm temperate zone. They receive comparatively less solar insolation. But summer are equally hot in north India because of hot local wind called **'loo'**. Winter are very cold due to cold waves brought by the **western disturbances.**
- Some places in Himalayas record low temperatures particularly in winter.
- Coastal regions see moderate climatic conditions irrespective of latitudinal position.

Distance from the Sea

- Coastal regions have moderate or equable or maritime climate whereas interior locations are deprived of the moderating influence of the sea and experience extreme or continental climate.
- The monsoon winds first reach the coastal regions and hence bring good amount of rainfall.

Himalayas and Indian Climate

- This is the most important factor that influences Indian Climate.
- The Himalayas act as a climatic divide between India and Central Asia.
- During winter, Himalayas protect India from cold and dry air masses of Central Asia.
- During monsoon months these mountain ranges act as an effective physical barrier for rain bearing south-west monsoon winds.
- Himalayas divide the Bay of Bengal branch of monsoon winds into two branches – one branch flowing along the plain regions towards north-west India and the other towards South-East Asia.
- If the Himalayas were not present, the monsoon winds would simply move into China and most of the north India would have been a desert.

Physiography and Indian Climate

- Physiography is the most important factor that determines the mean annual rainfall received by a region.
- Places on the windward side of an orographic barrier receive great amount of rainfall where as those on the leeward side remain arid to semi-arid due to rain-shadow effect.
- Example: The south-west monsoon winds from the Arabian sea strike almost perpendicular at the Western Ghats and cause copious rainfall in the Western Coastal plain and the western slopes of the Western Ghats.

- On the contrary, vast areas of Maharashtra, Karnataka, Telangana, Andhra Pradesh and Tamil Nadu lie in rain-shadow or leeward side of the Western Ghats and receive scanty rainfall.
- Monsoons winds flowing in Rajasthan and Gujarat are **not obstructed by any orographic barrier** and hence these regions receive no rainfall.
- Monsoon winds blow almost parallel to Aravalis and hence there is no orographic rainfall.
- No convection cell or vertical wind movements arise in Rajasthan and Gujarat: Monsoon winds blow towards low pressure cells in Tibet and hence only horizontal wind movements exist in Gujarat and Rajasthan
- Sub-tropical high pressure belt: In winter the region experiences strong divergence because of the STJ – Sub-Tropical Jet.
- Mawsynram and Cherrapunji are the wettest places on earth with mean annual rainfall over 1000 cm.
- Copious rainfall in these places is due to funneling effect followed by orographic upliftment.

Monsoon Winds and Indian Climate

- The most dominating factor of the Indian climate is the ‘monsoon winds’.
- Important features of Indian Monsoons are
- Sudden onset (sudden burst)
- Gradual progress
- Gradual retreat
- Seasonal reversal of winds
- The complete reversal of the monsoon winds brings about a sudden change in the seasons.
- The harsh summer season suddenly giving way to monsoon or rainy season.
- The south-west monsoons from the Arabian sea and the Bay of Bengal bring rainfall to the entire country.
- The north-eastern winter monsoon do not cause much rainfall except along the Caromandel coast (TN coast) after getting moisture from the Bay of Bengal.

Upper Air Circulation

- The changes in the upper air circulation over Indian landmass is brought about by Jet streams.

Westerly Jet Stream

- Westerly jet stream blows at a very high speed during winter over the sub-tropical zone.
- Southern branch of the jet stream exercises a significant influence on the winter weather conditions in India.
- This jet stream is responsible for bringing western disturbances from the Mediterranean region in to the Indian sub-continent.
- Winter rain and heat storms in north-western plains and occasional heavy snowfall in hilly regions are caused by these disturbances.
- These are generally followed by cold waves in the whole of northern plains.

Easterly Jet Stream

- Reversal in upper air circulation takes place in summer due to the apparent shift of the sun's vertical rays in the northern hemisphere.
- The westerly jet stream is replaced by the easterly jet stream which owes its origin to the heating of the Tibet plateau.
- This helps in the sudden onset of the south-west monsoons.

El-Nino, La Nina, ENSO and Indian Climate

El Nino

- Adversely affects monsoon rainfall and cyclogenesis in Bay of Bengal.
- Good for cyclogenesis in Arabian Sea.
- Droughts are common during El Nino events due to less monsoonal and cyclonic rainfall.

La Nina

- Good for monsoons and cyclogenesis in Bay of Bengal.
- Suppressed cyclogenesis in Arabian Sea.
- Floods are common.

ENSO

- Southern Oscillation is simply the oscillation or alternating positions of low pressure and high pressure cells over eastern and western Pacific.
- Southern Oscillation coinciding with El Nino is called ENSO or El Nino Southern Oscillation. (SO usually coincides with EL Nino. This why El Nino is usually referred to as ENSO)
- ENSO = [warm water in eastern Pacific + low pressure over eastern Pacific] + [cool water in western Pacific + high pressure in western Pacific]
- Climatic conditions same as El Nino.

Tropical Cyclones and Western Disturbances

- Tropical cyclones originate in the Bay of Bengal and Arabian Sea and the influence large parts of the peninsular India.
- Majority of the cyclones originate in the Bay of Bengal and influence the weather conditions during the south-west monsoon season (low intensity cyclones).
- Some cyclones are born during the retreating monsoon season, i.e., in October and November (high intensity cyclones) and influence the weather conditions along the eastern coast of India.
- The western disturbances originate over the Mediterranean sea and travel eastward under the influence of westerly jet stream.
- They influence the winter weather conditions over most of Northern-plains and Western Himalayan region.

Seasons of India

1. Cold weather season
2. Hot weather season
3. The Southwest Monsoon season
4. The Northeast Monsoon season

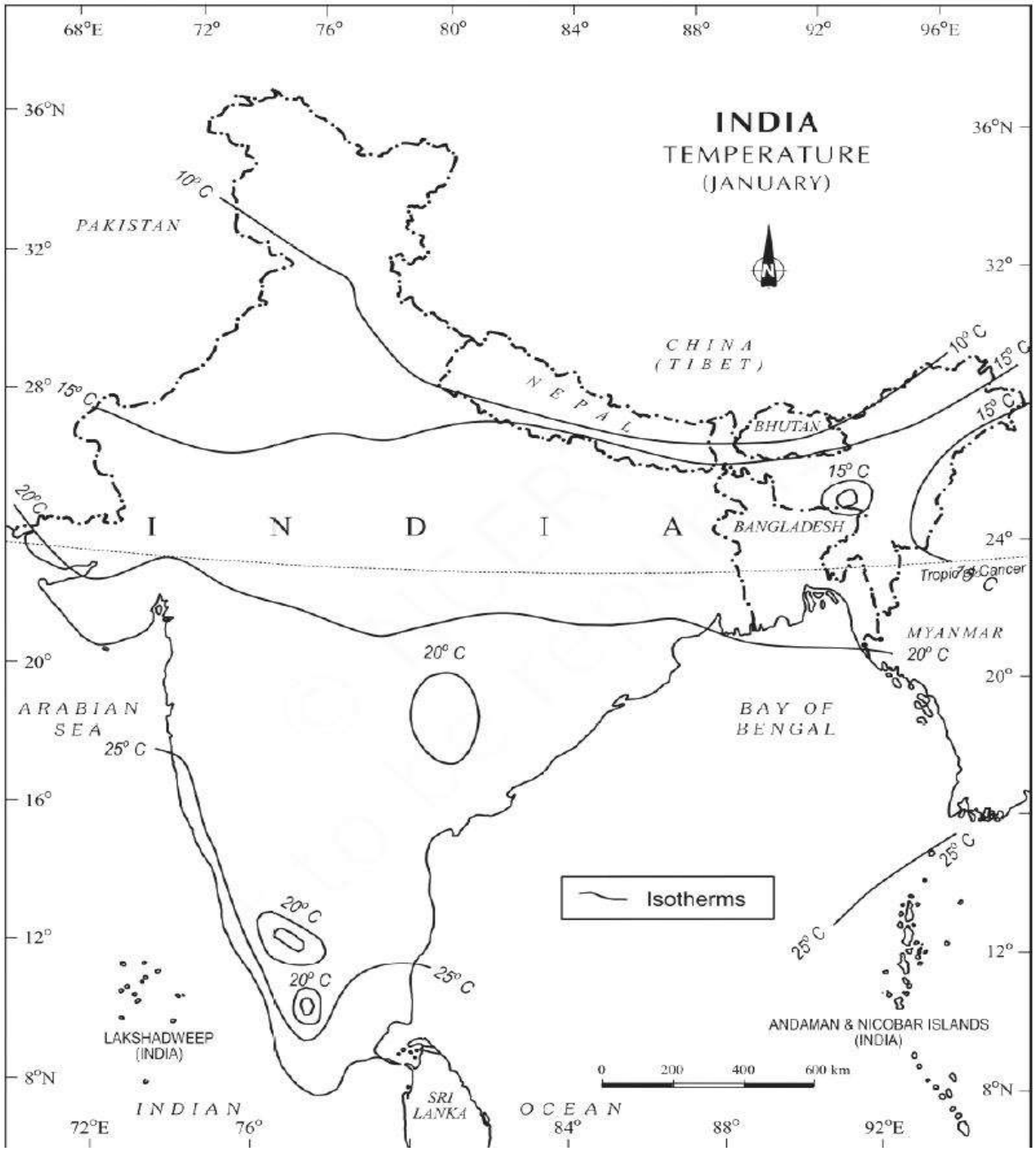
Cold weather season (December – February)

- Sets in by Mid-November in North India
- December and January are the coldest months in northern plains
- The mean daily temperature is below 21°C over most part of North India
- Night temperature goes below freezing point in Rajasthan and Punjab

- The states like Punjab, Haryana and Rajasthan are far away from sea
- Snowfall in the Himalayas create cold waves
- During February, cold winds from Caspian Sea and Turkmenistan bring cold wave along with frost and fog.
- The Peninsular India does not have any well-defined cold season because of moderating influence of sea and proximity to equator
- For example, the January temperature for Thiruvananthapuram is 31°C and for June it is 29.5°C

Pressure and Winds: High pressure over northern plain (1019mb) and in south India (1013mb) the air pressure is comparatively lower

- Winds start blowing from HP to LP
- As the pressure gradient is low, winds blow at 3 to 5km/hr.


INDIA
TEMPERATURE
(JANUARY)
68°E
72°
76°
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PAKISTAN
CHINA
(TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
I N D I A
Tropic of Cancer
ARABIAN
SEA
BAY OF
BENGAL
INDIAN
OCEAN
SRI
LANKA
LAKSHADWEEP
(INDIA)
ANDAMAN & NICOBAR ISLANDS
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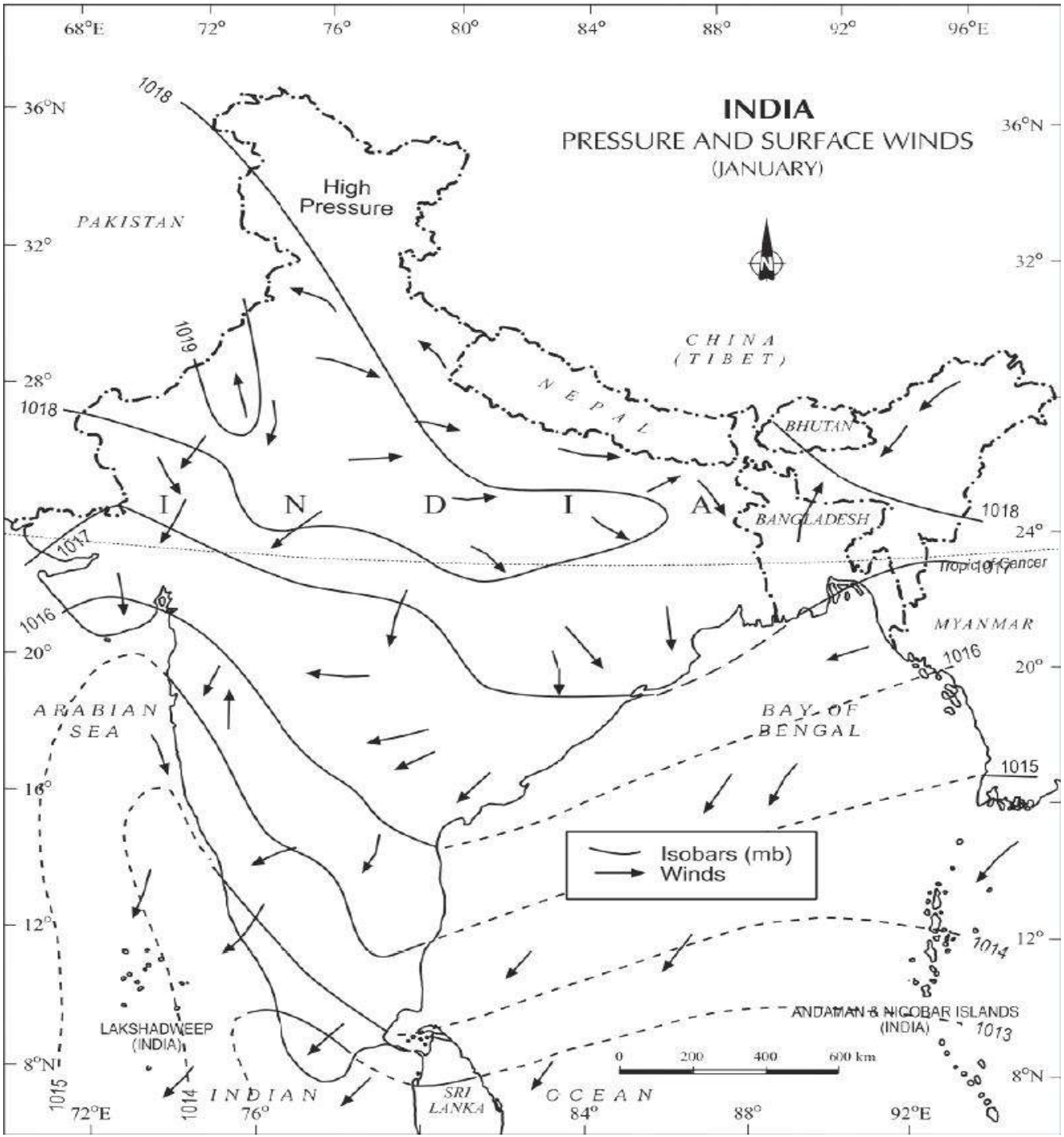
INDIA
PRESSURE AND SURFACE WINDS
(JANUARY)
High Pressure
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
I N D I A
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
Tropic of Cancer
Isobars (mb)
Winds
0 200 400 600 km
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96°E
36°N
32°
28°
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- Shallow depression is developed east of the Mediterranean Sea and travel eastwards across West Asia, Iran, Afghanistan, Pakistan and Northwest India.

Rainfall: Most part of India does not have rainfall in winter season...as the winds are from land to sea...anti-cyclonic circulation on land.

Exceptions: 1. Punjab , Haryana, Delhi and Western UP get rainfall from temperate cyclone from Mediterranean Sea..it is beneficial to rabi crops. It ranges from 25mm to 53mm.

2. It is in the form of snow fall in the Himalayan Region
3. Arunachal Pradesh and Assam also have 25mm to 50mm rainfall

Hot weather season (March – May)

- The apparant northward movement of the Sun increases temperature in India
- March (38°C), April (38°C - 43°C), May (48°C) in most parts of India
- There is a moderating condition in South India due to sea influence...the temperature varies from 26°C to 32°C...in Western Ghats it is below 25°C due to altitude.
- The isotherms are parallel to the coast indicating that it is increasing from coast to interior, not from north to south..
- The daily minimum temperature rarely goes below 26°C during this season

Pressure and winds: ITCZ is centered at 25°N in July..the elongated low pressure area extends from Thar desert to Chhota Nagpur plateau

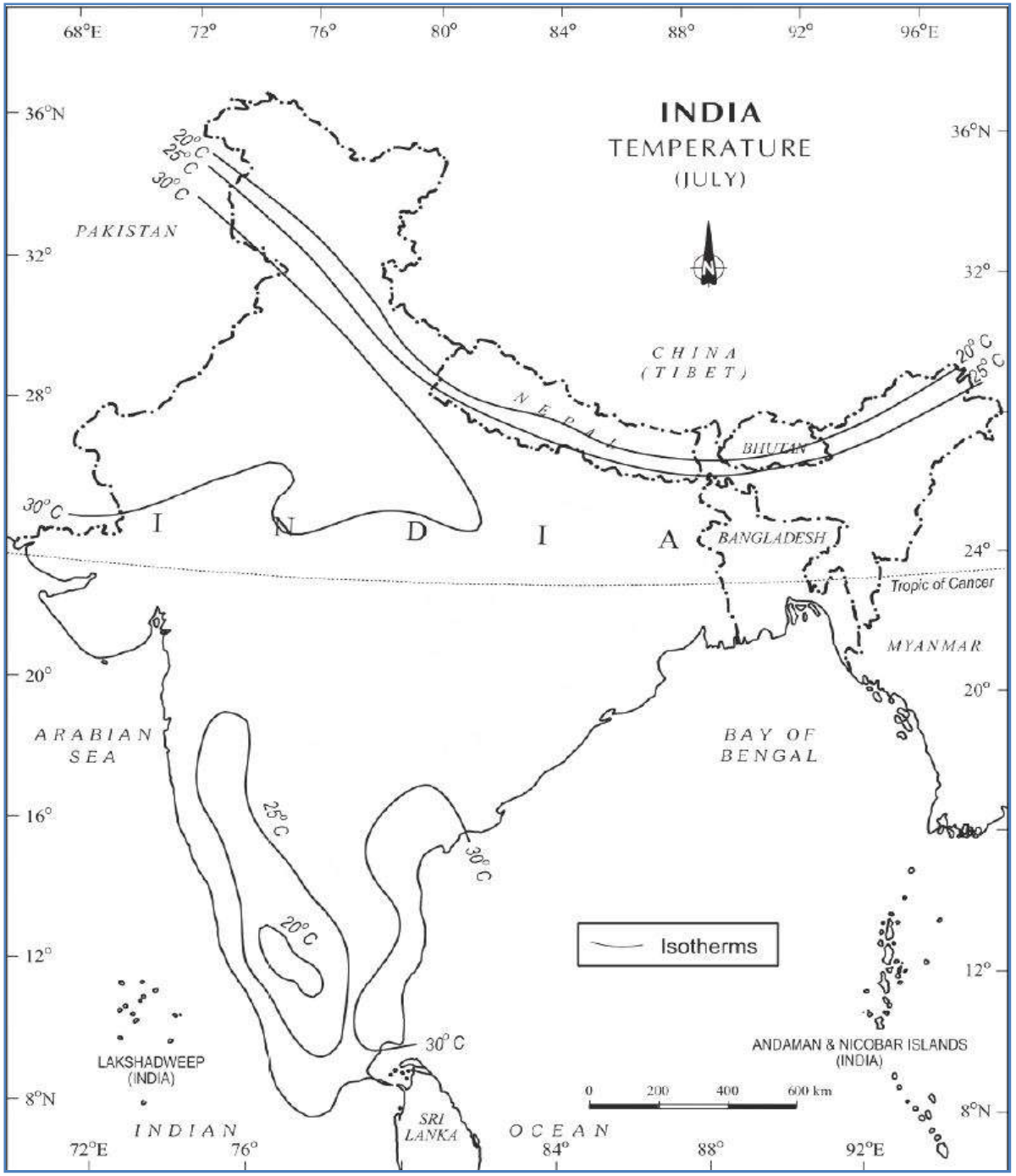
- the location of ITCZ attracts surface winds which are southwesterly along the west coast, coastal West Bengal and Bangladesh....easterly and southeasterly in the North Bengal and Bihar
- In the heart of ITCZ in the northwest, dry and hot winds called 'Loo' blow in the afternoon and extend till midnight...They blow across Eastern Rajasthan, Punjab, Haryana, U.P., Bihar...bringing respite from oppressing heat during May
- Local storms cause violent winds, torrential rain with hailstorms

Local storms of Hot weather season

1. Mango showers: pre-monsoon showers at the end of summer in Kerala and coastal areas of Karnataka....helps early ripening of mangoes
2. Blossom showers: coffee flowers blossom in Kerala and nearby areas
3. NorWesters: evening thunderstorms in Assam and Bengal...called ‘Kalbaisakhi’....useful for tea, jute and rice cultivation...In Assam these storms are known as ‘bardoli Chheerha’
4. Loo winds: Hot and dry wind in the northwest

The Southwest Monsoon (June – September)

- In June, intense low pressure over north and northwest India attract trade winds from southern hemisphere
- The southeast trade winds after crossing equator blow over Arabian Sea and Bay of Bengal as southwest winds...and caught up in air circulation over India
- The sudden onset of rain with violent thunder and lightning is ‘burst’ of monsoon
- The monsoon may burst in the first week of June along the coastal areas of Kerala, Karnataka, Goa and Maharashtra
- It reduces the temperature by 5°C to 8°C
- Two branches: 1. Arabian Sea branch 2. Bay of Bengal Branch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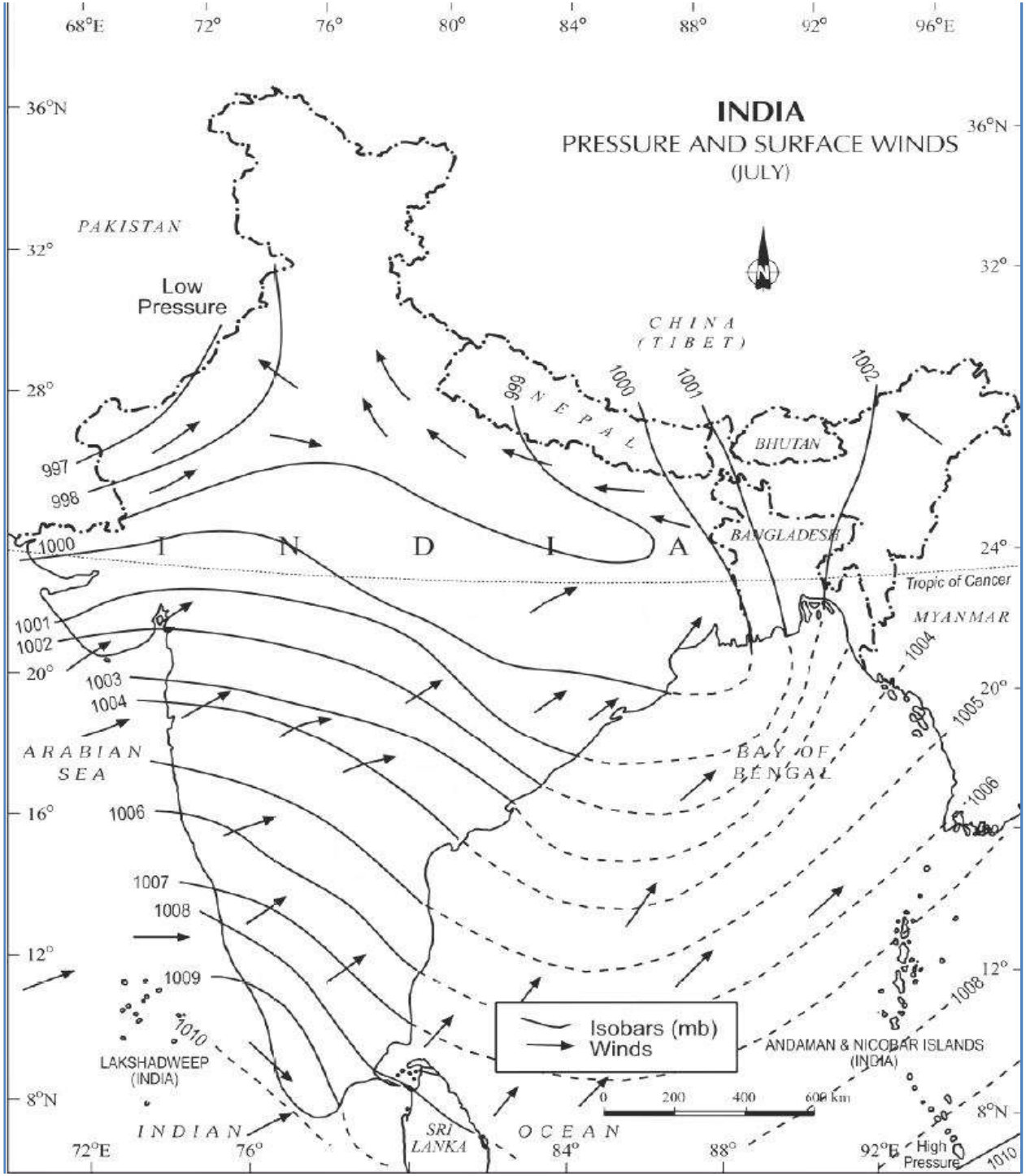
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INDIA
Low Pressure
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ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
High Pressure
997
998
999
1000
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1002
1003
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1005
1006
1007
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1009
1010
Isobars (mb)
Winds
0 200 400 600 km

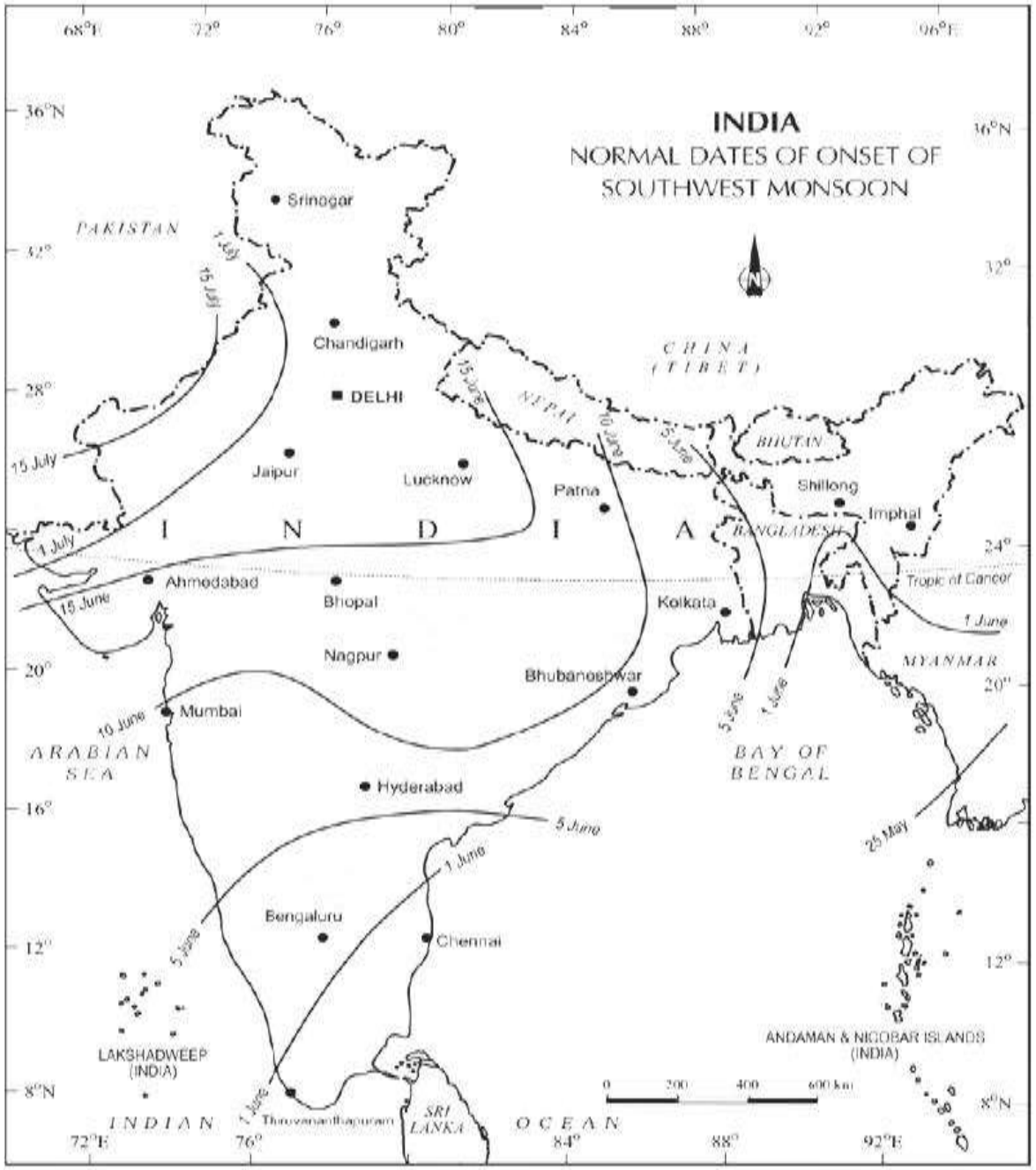


Figure 4.5 : India : Normal Dates of Onset of the Southwest Monsoon

Arabian Sea branch: Gives heavy rainfall of 250 – 400 cm along the west coastal plain and windward side of Sahyadris

- The moisture laden winds climb up the Western Ghats and give rainfall....the winds climb down it becomes dry... So the leeward side get little amount of rainfall
- Second part of Arabian sea branch hit the Mumbai coast and enter through Narmada and Tapi valleys
- Third part blow across Saurashtra Peninsula and blow along the Aravallis

Bay of Bengal branch: hit the coast of Myanmar and southeast Bangladesh. The Arakan hills deflect a big portion of the branch into Indian sub-continent..

- One part goes upto Brahmaputra valley and cause heavy rainfall in the north and northeast. Mawsynram in Khasi hills gets the highest average rainfall in the world.
- Another part moves westwards along the Ganga plain upto Punjab

Northeast Monsoon (Retreating Monsoon): During October and November

- The low pressure trough moves southwards along with the march of the Sun at the end of September
- The monsoon retreats from western Rajasthan in the first week of September, withdraws from Gujarat, Ganga Plain and central highlands at the end of September
- Dry weather in north India; rainiest months for eastern Peninsular
- The widespread rain is associated with cyclonic depressions in the Bay of Bengal...
- The thickly populated region along the east coastal plain is targeted by the cyclones every year.

Distribution of Rainfall

Areas of very high rainfall

- Areas receiving an annual rainfall of 200 cm and above.
- These include western side of Western Ghats [Thiruvananthapuram in the south to Mumbai in the north].
- The average annual rainfall in this belt is 200-400 cm.
- Assam, Nagaland, Meghalaya, Mizoram, Arunachal Pradesh, Sikkim, parts of Manipur, Tripura and north-eastern tip of West Bengal also receive 200 cm or more, with isolated pockets receiving over 400 cm.
- Meghalaya (the abode of clouds) is the wettest part of the country with Mawsynram and Cherrapunji getting 1,221 and 1,102 cm of annual rainfall respectively.

Areas of high rainfall

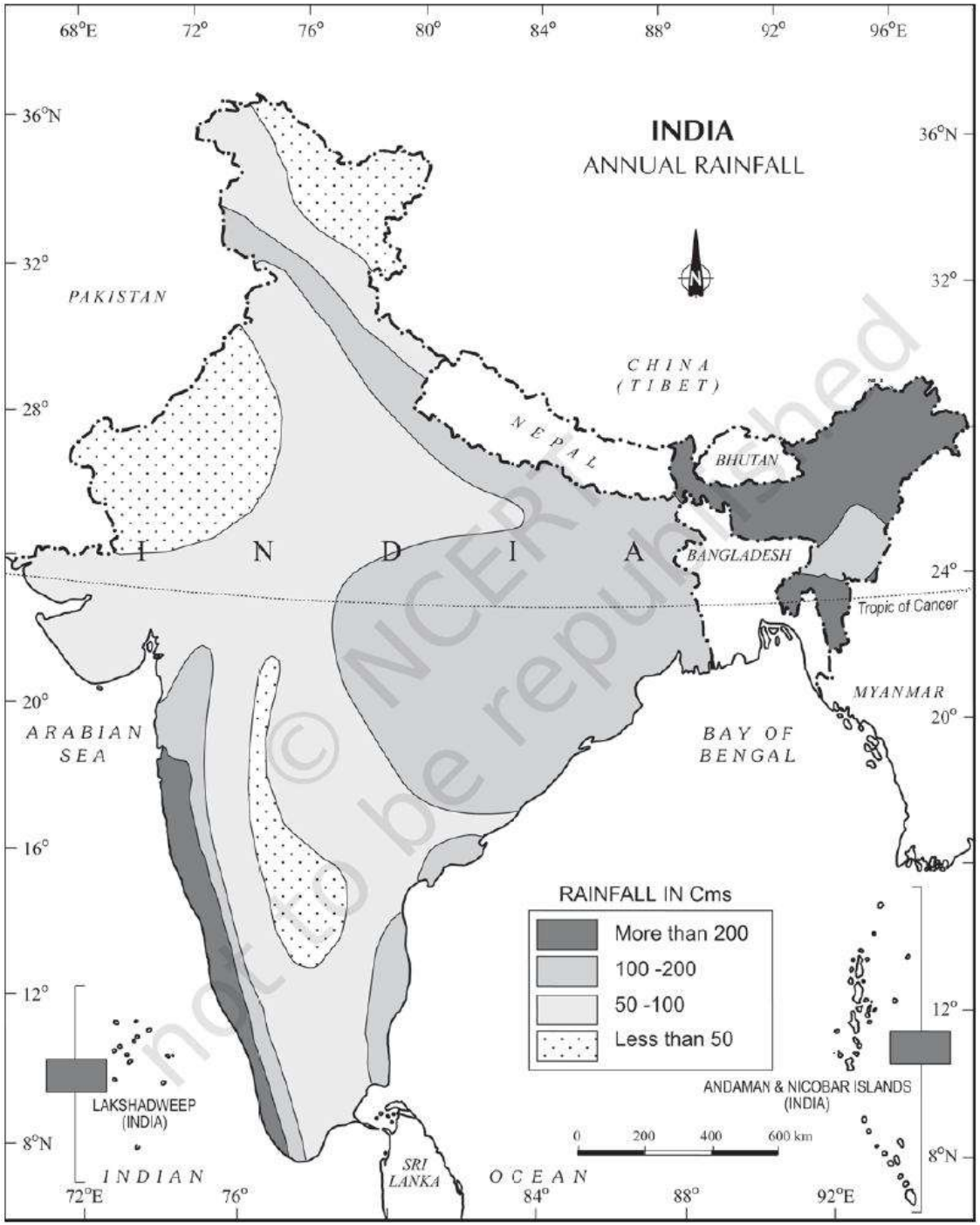
- 100-200 cm annual rainfall.
- Eastern slopes of the Western Ghats, major part of the northern plain, Odisha, Madhya Pradesh, Andhra Pradesh and Tamil Nadu.

Areas of low rainfall

- 50-100 cm annual rainfall.
- Large parts of Gujarat, Maharashtra. western Madhya Pradesh, Andhra Pradesh, Karnataka, eastern Rajasthan, Punjab, Haryana and parts of Uttar Pradesh.

Areas of very low rainfall

- These are desert and semi-desert areas receiving less than 50 cm of annual rainfall.
- They include large areas of western Rajasthan, Kachchh and most of Ladakh region of Jammu and Kashmir.

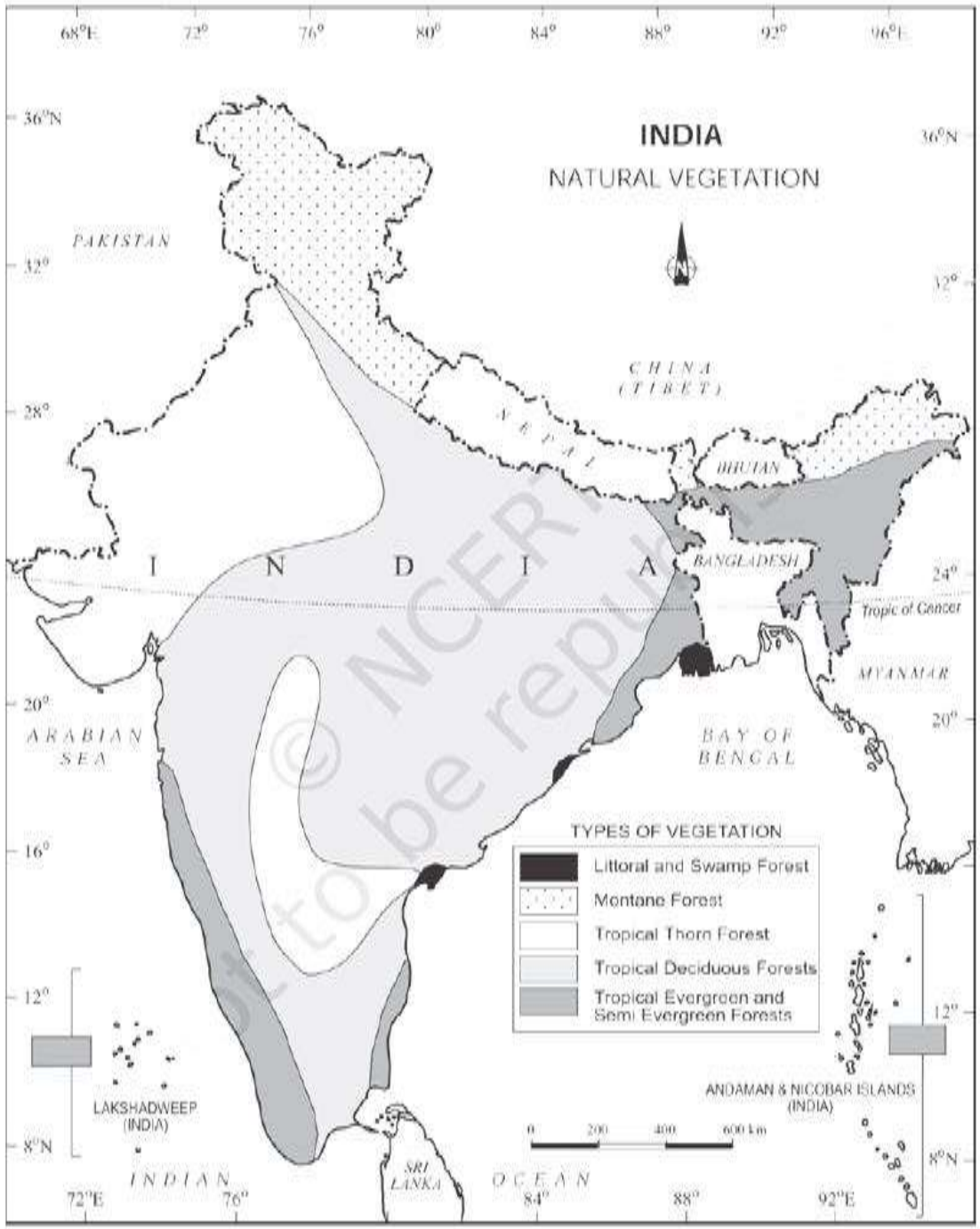


Impact of Monsoon

- About 64 percent people of India depend on agriculture for their livelihood and agriculture it turn depends on monsoon
- Regional variations in monsoon climate help in growing various types of crops
- Variability of rainfall brings drought and flood in some parts of the country where proper irrigation is not developed
- Agricultural prosperity of India depends on the timely and adequately distributed rainfall. If it fails, agriculture is adversely affected.
- Sudden monsoon burst creates problem of soil erosion over large areas in India
- Winter rainfall is beneficial for rabi crops

Natural Vegetation

- It refers to a plant community that has been left undisturbed over long period of time...so as to allow individual species to adjust themselves to climate and soil conditions..
- Natural vegetation vs planted vegetation
- Natural vegetation in India reflects a perfect harmony with the relief and climatic conditions
- If one superimposes annual rainfall map, altitude map with vegetation map it corresponds well
- Depending upon the variations in climate and soil the vegetation of India changes from one region to another



- According to H.G. Champion (1936), the Indian forests have been classified as..

1. Tropical Evergreen Forests
2. Tropical Moist Deciduous Forests
3. Tropical Thorny Forests
4. Subtropical Montane Forests
5. Dry Deciduous Forests
6. The Himalayan Moist Forests
7. The Himalayan dry Temperate Forests
8. Montane Wet Temperate Forests
9. Alpine and sub-alpine Forests
10. Desert Vegetation
11. Tidal Forests

Tropical Evergreen Forests:

- Areas recording over 150 cm of average annual rainfall
- Temperature between 25°C to 27°C
- Areas: N.E. India, Parts of Western Ghats, Andaman and Nicobar, Upper Assam, Lower slopes of Eastern Himalayas, Odisha, Bhabar and Tarai regions
- If RF is >250cm: the forests are dense; composed of tall trees (45m), epiphytes, parasites, lianas and rattans
- Trees have multi-storeyed structures with good canopies
- The forest floor lacks grasses because of deep shade
- There are canes, palms, bamboos, ferns, climbers which make passage difficult
- Species: rosewood, mahogony, ebony, white cedar, toon, dhup, palaquinu, mesua, collophyllum, hopea, gurjan, chaplas, agor, muli and bamboo

- RF between 200 and 250cm: Semi-evergreen forests
- They are found along the Western Ghats, upper Assam, Slopes of Himalayas and Odisha
- Varieties are aini, semul, gutel, mundane, hopea, kadam, irul, rosewood, laurel, haldu, kanju, holloch, champa and mesua.

Tropical Moist Deciduous Forests

- Found all over the country where rainfall ranges between 100 – 200cm.
- Theses are typical 'monsoon' forests with 'teak' and 'sal' as the dominant species
- Distributed in Sahyadris, the north-eastern parts of the Peninsula and along the foothills of the Himalayas
- The typical landscape consists of tall teak trees with sal, bamboos and shrubs
- Sandalwood, Shisham, Hurra and Khair – other species

Tropical Dry Deciduous Forests

- Found where average rainfall ranges between 100-150 cm.
- Characterised by closed uneven canopies
- Light reaches the ground to permit the grasses and the climbers to grow
- Grasses and shrubs appear during the rainy season
- Acacia, Jamun, modesta, pistacia – main trees.

Tropical Thorny Forests

- It is the degraded version of the moist deciduous forest
- Average rainfall between 75-100cm; temperature: 16°C to 22.5°C
- Found in Peninsular India, Rajasthan, Haryana, Punjab, Western U.P., Kachchh and Madhya Pradesh
- Trees: acacia, wild-palms,euphorbias, jhad, tamarix, khair, kokko, dhaman, erunjha, cacti, kanju and palas.

Sub-tropical Montane Forests

- Average rainfall 100-200cm; temperature between 15°C to 22°C
- Found in north-western Himalayas (except Ladakh and Kashmir), Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, slopes of the north-eastern hill states.
- Chir (pine) is the main tree; Oak, jamun and rhododendron are the other varieties.

The Himalayan Moist Forests

- Found in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, northern hilly parts of North Bengal
- Altitude varies from 1000 to 2000 metres
- Coniferous varieties are largely found
- Oak, chestnut, chir, sal, shrubs and nutritious grasses

The Himalayan Dry Temperate Forests

- Found in Jammu and Kashmir, Lahul, Chamba, Kinnaur (Himachal Pradesh), and Sikkim
- Coniferous forests with shrubs
- Deodar, oak, chilgoza, ash, maple, olive, mulberry, willow, celtis, and parrotia

Montane Wet Temperate Forests

- Found in the entire Himalayas from Jammu and Kashmir to Aruchal Pradesh
- Altitudes 1500 to 3500 m
- Rainfall 100 to 250 cm
- Temperature 12°C to 15°C
- Oak, fir, spruce, deodar, magnolia, celtis, chestnut, cedar, maple, silver fir, kail
- Also contain scrubs, creepers and ferns
- Alpine pastures are found above 3500m. They are known as '**Margs**' in Kashmir and '**Bugyals**' in Uttarakhand

Alpine and Sub-AlpineForests

- Found all along the Himalayas at altitudes ranging between 2500 to 3500 metres
- Characterised with short dwarf conifers and lush green nutritious grasses
- Kail, spruce, yew, firs, birch, honeysuckle, artemesia, potentilla

Desert vegetation

- Confined to the west of Aravallis in Rajasthan and northern Gujarat
- Rainfall is less than 50 cm
- Diurnal and annual range of temperature are high
- Acacia, cacti, jhar, khejra, kanju – main plant varieties

Tidal (Mangrove) forests

- Along the coastal areas of the Bay of Bengal in the States of West Bengal, Odisha, Andhra pradesh, and Tamil Nadu....also along the coastal areas of Kachch, kathiawar and Gulf of Khambat
- The famous delta of Sundarban is covered by the Sundari trees which supply hard durable timber for construction and boat making

Soils of India

- A number of attempts have been made to classify the soils of India during the last century.
- The first scientific classification of Indian soils was made by Voeleker (1893) and Leather (1898).
- According to them, Indian soils may be classified into four categories, namely

1. Alluvial
2. Regur (or) Black
3. Red
4. Laterite soils

- The All India Soil and Land Use Survey Organisation attempted a classification of soils of India in 1956 based on texture, structure, colour, pH value and porosity.
- In 1957, the NATMO published a soil map of India in which Indian soils were classified into six major groups and 11 sub-groups.
- In 1963, ICAR under the supervision of S.P. Ray Chaudhry, published a soil map of India with 7 groups.
- ICAR recently classified Indian soils into the following groups...

1. Alluvial Soils
2. Red Soils
3. Regur Soils (Black Soils)
4. Desert Soils
5. Laterite Soils
6. Mountain Soils
7. Red and Black Soils
8. Grey and Brown Soils
9. Sub-montane Soils
10. Snowfields

Alluvial Soils: occupy 43.4 per cent of the total area.

- Occur mainly in the Satluj-Ganga-Brahmaputra plains
- Also found in the valleys of Narmada, Tapti and in the eastern and western coastal plains
- Mainly derived from the debris brought down from the Himalayas or from the silt left out by the retreating sea.
- Colour varies from light grey to ash grey
- Texture is sandy to silty-loam
- Have a well-developed profile in levelled areas

- These soils are divided into a) Khadar soil and b) Bhangar soil.
- Khadar soils are low-lying, frequently inundated by floods during the rainy season.
- Khadar soils occupy the flood plains of the rivers and is enriched by fresh silt deposits every year.
- Bhangar soils are above the flood level. It is well-drained but contains concretion of impure calcium carbonate.
- Alluvial soils are rich in humus, phosphoric acid, lime and organic matter, but deficient in potash
- Suitable for wheat, rice, maize, sugarcane, pulses, oilseeds, barseem (fodder), fruits and vegetables.

Red soils occupy the second largest area covering 18.5 per cent.

- Found over the Peninsula from Tamil Nadu in the south to Bundelkhand in the north and Rajmahal in the east and Kathiawar and Kachch in the west.
- Developed on Archaean granite
- The colour is mainly due to the presence of ferric oxides
- Generally, the top layer is red, while the horizon below is yellowish in colour
- The texture varies from sand to clay and loam
- They are porous and friable structure.
- They are deficient in lime, phosphate, magnesia, nitrogen, humus and potash.
- In the uplands, they are thin whereas in the lowlands they are deep and fertile
- Suitable for wheat, cotton, pulses, tobacco, millets oilseeds, potato and fruits

Black or Regur soils are the third largest group in India.

- Occupy 15 per cent of the area
- Parent material from weathered rocks of Cretacious lava
- They stretch over the greater part of Gujarat, Maharashtra, western M.P., north-western Andhra, Karnataka, TN, Rajasthan, Chhattisgarh and Jharkhand
- They are clayey in texture
- Rich in iron, lime, calcium, potash, aluminium and magnesium
- Deficient in nitrogen, phosphorous and organic matter
- These soils have high water-retention capacity
- During rainy season it becomes wet and compact, in the dry season, it shrinks and cracks develop
- Suitable for cotton, pulses, millets, linseed, castor, tobacco, sugarcane, vegetables and citrus fruits

Desert soils account for 4.42 per cent of the total area

- Developed under the arid and semi-arid conditions and deposited by wind action
- Found mainly in Rajasthan, north Gujarat, western part of Haryana, south western part of Punjab
- These soils are sandy to gravelly with low organic matter, low nitrogen.
- Contain high percentage of soluble salts
- Low moisture content and low water retention capacity
- Indira Gandhi canal has transformed this region into agriculturally productive one
- Bajra, pulses, guar, fodder – suitable crops

Laterite soils are typical soils of the monsoon climate which is characterised by seasonal rainfall

- The term ‘laterite’ is derived from the Latin word ‘later’ meaning ‘brick’
- These soils, when wet, are as soft as butter
- The alternating wet and dry seasons lead to the leaching away of the siliceous matter of the rocks leading to the formation of this soil
- Mainly found in the highland areas of the plateau
- The soils in the higher areas are more acidic than those in the low lying areas
- Also found in the hills of Western Ghats, Eastern Ghats, Rajmahal hills, Satpura, Vindhya, Odisha, Chhattisgarh, Jharkhand, West Bengal, North Cachar hills of Assam, the Garo hills of Meghalaya

- Rich in iron and aluminium, but poor in nitrogen, potash, potassium, lime and organic matter.
- Paddy, ragi, sugarcane and cashewnuts can be grown

Mountain Soils are found in the valleys and hill slopes of the Himalayas between 200 and 300 metres

- They vary from silt to loam
- Colour is dark brown
- Acidic in character with low humus content
- Maize, paddy, legumes, fodder and fruits can be cultivated

Red and Black soils are found in isolated patches in Bundelkhand, to the east of Aravallis in Rajasthan and Gujarat.

- Developed over the granite, gneiss, quartzite of the Archaean and Pre-cambrian period
- Less productive but perfom well under proper irrigation
- Maize, bajra, millets, pulses and oilseeds can be grown.

Grey and brown soils have been formed by the weathering of granite, gneiss and quartzite

- Loose and friable soils
- Found in Rajasthan and Gujarat

Submontane soils are found in the Tarai region of the sub-montane stretching from Jammu and Kashmir to Assam in a narrow belt

- Formed by the deposition of the eroded material from the Shiwaliks
- Fertile and supports luxuriant growth of forests
- The clearing of forests for agriculture has made this are highly susceptible to soil erosion

Saline and alkaline soils are characterised by the presence of sodium chloride and sodium sulphate

- The saline and alkaline efflorescence appears on the surface as a layer of white salt through capillary action
- Called by different names...reh,kallar,usar,rakar,thur,karl and chopan
- Found in Rajasthan, Haryana, Punjab, UP, Bihar and Maharashtra
- Poor in nitrogen, calcium and have low water bearing capacity

Peaty and Marshy soils originate in the areas of heavy rainfall where adequate drainage is not available

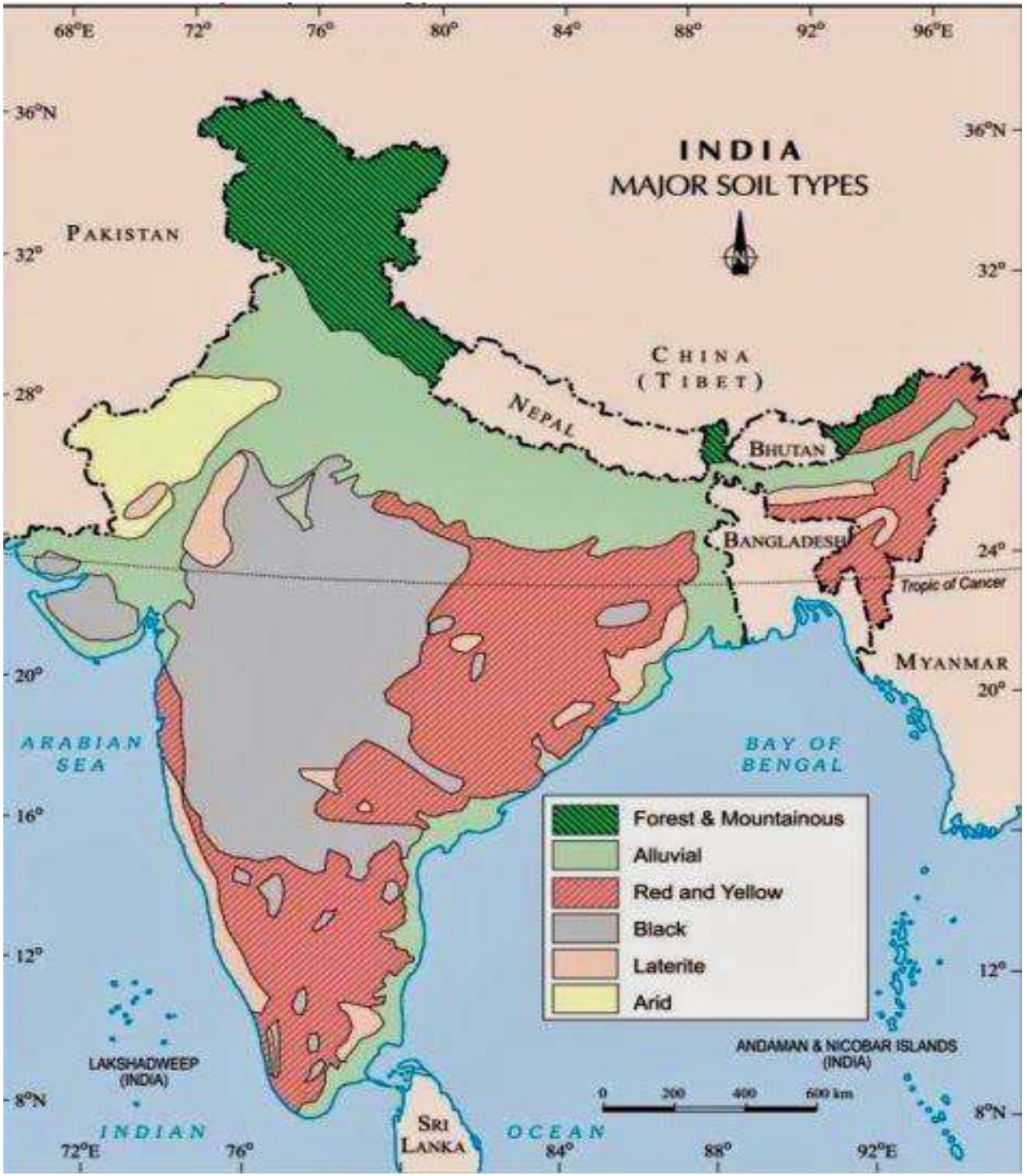
- These are submerged during the rainy season and utilised for paddy cultivation
- Rich in organic matter, highly saline, deficient in phosphate and potash
- Found in Kottayam and Alappuzha districts of Kerala and in the Sunderban delta
- Also found in the deltas of Mahanadi, Godavari, Krishna, Kaveri and the Rann of kachchh.

Karewa soils are the lacustrine deposits in the valley of Kashmir and in Bhadarwah valley of the Doda district of Jammu division

- These are the flat-topped mounds that border the Kashmir valley on all sides
- They are composed of fine silt, clay, sand and bouldery gravel
- Devoted to the cultivation of saffron, almond, walnut, apple and orchards

• Snow fields are found in the high peaks of the greater Himalayas, Karakoram, Ladakh, Zaskar.

- It remains frozen and unsuitable for crop cultivation


INDIA
MAJOR SOIL TYPES
N
68°E
72°
76°
80°
84°
88°
92°
96°E
36°N
32°
28°
24°
20°
16°
12°
8°N
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
Tropic of Cancer
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
Forest & Mountainous
Alluvial
Red and Yellow
Black
Laterite
Arid
0 200 400 600 km

Soil Characteristics

- Knowing a soil's water, mineral, and organic components and their proportions can help us determine its productivity.

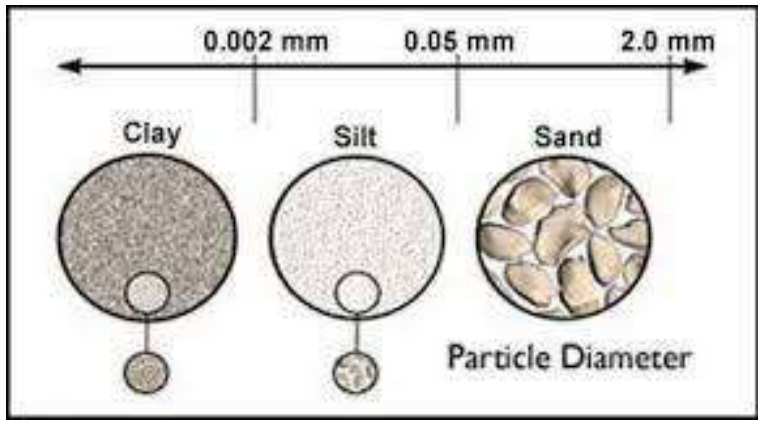
1. **Colour:** A soil's colour is generally related to its physical and chemical characteristics. E.g.

- Soils rich in humus tend to be dark because decomposed organic matter is black or brown.
- Soils with high humus content are usually very fertile, so dark brown or black soils are often referred to as 'rich'.
- Red or yellow soils typically indicate the presence of iron.

2. Texture

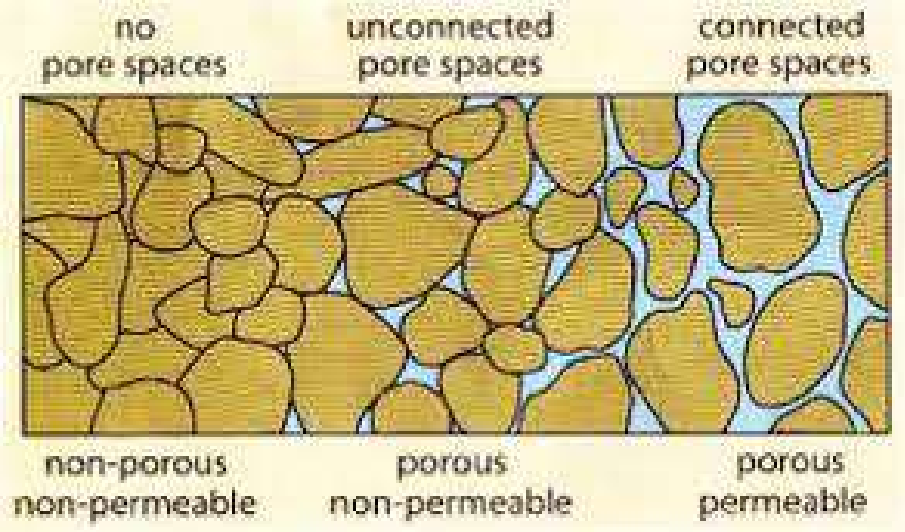
The soil texture refers to the coarseness/fineness of the mineral matter in the soil. It is determined by the proportion of the sand, silt and clay particles:

- Clay: Particle Size – diameters less than 0.002 millimetre
- Silt: Particle Size – diameters between 0.002 millimetres to 0.05 millimetres.
- Sand: Particle Size – diameters between 0.05 and 2 millimetres.
- [Rocks larger than 2 millimetres are regarded as pebbles, gravel, or rock fragments and technically are not soil particles.]



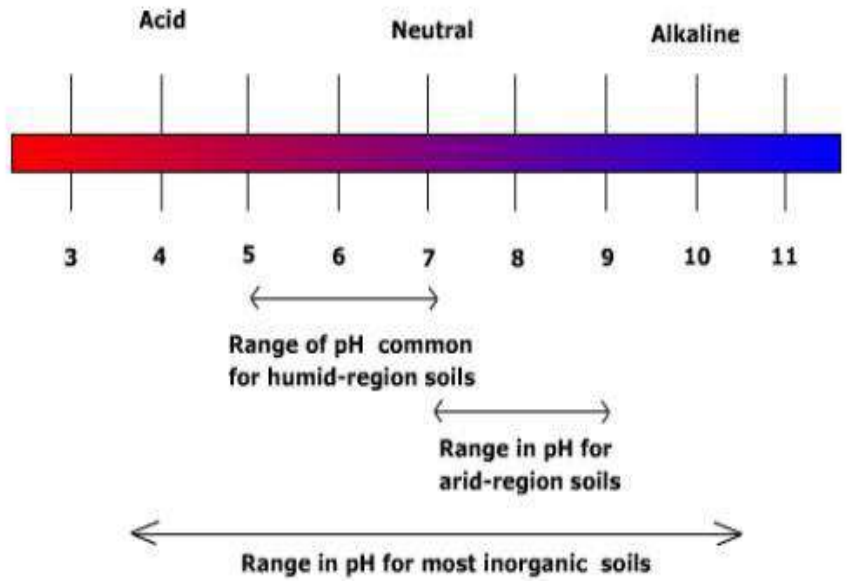
3. Structure

- While the soil texture describes the size of soil particles, soil structure refers to the arrangement of the soil particles. The way in which sand, silt, clay and humus bond together is called soil structure. Structure can partially modify the effects of soil texture.
- Some structural characteristics of soil:
- Permeability – The ease with which liquids/gases can pass through rocks or a layer of soil is called permeability. It depends on the size, shape and packing of particles. It is usually greatest in sandy soils and poor in clayey soils.
- Porosity – The volume of water which can be held within a soil is called its porosity. It is expressed as a ratio of volume of voids (pores) to the total volume of the material.



4. **Soil Chemistry – Acidity or Alkalinity**

- An important aspect of soil chemistry is acidity, alkalinity (baseness), or neutrality.
- Low pH values indicate an acidic soil, and a high pH indicates alkaline conditions. Most complex plants grow only in the soils with levels between pH 4 and pH 10 but optimum pH varies with the plant species.
- In arid and semi-arid regions, soils tend to be alkaline and soils in humid regions tend to be acidic.
- To correct soil alkalinity and to make the soil more productive, the soil can be flushed with irrigation water.
- Strongly acidic soils are also detrimental to plant growth, but soil acidity can generally be corrected by adding lime to the soil.



- The National Bureau of Soil Survey and the Land Use Planning an Institute under the control of the Indian Council of Agricultural Research (ICAR) did a lot of studies on Indian soils. In their effort to study soil and to make it comparable at the international level, the ICAR has classified the Indian soils on the basis of their nature and character as per the **United States Department of Agriculture (USDA) Soil Taxonomy**.
- A taxonomy is an arrangement in a systematic manner; the USDA soil taxonomy has six levels of classification. They are, from most general to specific:
- order, suborder, great group, subgroup, family and series.

- 1. Alfisol
- 2.Andisol
- 3.Aridisol
- 4.Entisol
- 5.Gelisol
- 6.Histosol
- 7.Inceptisol
- 8.Mollisol
- 9.Oxisol
- 10.Spodosol
- 11.Ultisol
- 12.Vertisol

- Order: Entisols
- Suborder: Fluvents
- Great Group: Torrifluvents
- Subgroup: Typic Torrifluvents
- Family: Fine-loamy, mixed, superactive, calcareous, Typic Torrifluvents
- Series: Jocity, Youngston.

ICAR has classified the soils of India into the following order as per the USDA soil taxonomy

Sl. No.	*Order*	*Area (in Thousand Hectares)*	*Percentage*
(i)	Inceptisols	130372.90	39.74
(ii)	Entisols	92131.71	28.08
(iii)	Alfisols	44448.68	13.55
(iv)	Vertisols	27960.00	8.52
(v)	Aridisols	14069.00	4.28
(vi)	Ultisols	8250.00	2.51
(vi)	Mollisols	1320.00	0.40
(viii)	Others	9503.10	2.92
	Total		**100**

Source : Soils of India, National Bureau of Soil Survey and Land Use Planning, Publication Number 94

- **Entisols** – Immature soils that lack the vertical development of horizons. These soils are often associated with recently deposited sediments from wind, water, or ice erosion. Given more time, these soils will develop into another soil type.
- **Inceptisols** – young soils that are more developed than entisols.
- **Vertisols** – heavy clay soils that show significant expansion and contraction due to the presence or absence of moisture. These are common in areas that have shale parent material and heavy precipitation.
- **Aridisols** – soils that develop in very dry environments.
- **Ultisols** – associated with humid temperate to tropical climates. Warm temperatures and the abundant variability of moisture enhance the weathering process and increase the rate of leaching in these soils.
- **Mollisols** – soils common to grassland environments

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Geography of India
Unit III

Syllabus: Irrigation And Agriculture: Irrigation and its Types – Multi-Purpose Projects. Agriculture: Distribution of Food Crops (Rice and Wheat), Cash Crops (Cotton,Jute,Sugarcane and Oil seeds), Plantation Crops(Tea and Coffee) Revolution:Green Revolution, Blue Revolutionand White Revolution.

Irrigation

Watering of agricultural plants through artificial means is called irrigation. Being a hot country with seasonal and irregular rainfall, it always needs irrigation to carry out agricultural activities during dry period.

Sources of Irrigation

In India, different sources of irrigation are used depending upon the topography, soils, rainfall, availability of surface or groundwater, nature of river (whether perennial or non-perennial), requirements of crops etc. The main sources of irrigation used in different parts of the country are

Canal irrigation
Well irrigation and
Tank irrigation

a) Canal Irrigation

It is the second most important source of irrigation in our country.

Canals are the effective source of irrigation in areas of low level relief, deep, fertile soils, perennial source of water and extensive command area. The canals are of two types:

1. Inundation Canals: In this, water is taken out directly from the rivers without making any kind of barrage or dam. Such canals are useful for the diversion of flood water from the rivers and remain operational during rainy season.

2. Perennial Canals: These are developed from perennial rivers by constructing barrage to regulate the flow of water. About 60 percent of the canal irrigated area falls in the northern plains of India,

b) Well Irrigation

A well is a hole or trough, usually vertical, excavated in the earth for bringing groundwater to the surface. Well irrigation is the most important source of irrigation. It is a cheap, dependable, and popular source of irrigation in the country. Well irrigation is unavoidable in the region of low rainfall and becomes an essential one where the canals and tank irrigation are not available. Wells are of two types:

i) Open wells

ii) Tube wells

1. Open Wells: This type of irrigation is widely practiced in the areas where groundwater is sufficiently available. The areas are in Ganga Plains, the deltaic region of Mahanadi, Godavari, Krishna, Cauvery and parts of Narmada and Tapti valleys.

2. Tube Wells: Tube wells are developed in the areas of low water table, sufficient power supply and soft subsurface geological units. Tube wells are predominant in the states of Gujarat, Maharashtra, Punjab, Madhya Pradesh and Tamil Nadu.

c) Tank Irrigation

A tank is a natural or man-made hollow on the surface developed by constructing a small bund around it across a stream. It is used to collect and store water for irrigation and other purposes. Irrigation by tanks is a very old system in India. It also includes irrigation from lakes and ponds.

The tank irrigation is popular in the peninsular India due to the following reasons:

1. The undulating relief and hard rocks make difficult to dig canals and wells.
2. Natural depressions serve as reservoirs.
3. Absence of perennial rivers.
4. Impermeable rock structure which do not permit percolation.
5. The scattered nature of population and agricultural fields

Modern irrigation methods

There are many ways in Modern Irrigation. Among them mostly practiced in India are drip irrigation, sprinklers and Rain Gun and central pivot irrigation

Drip Irrigation Method

It was first developed. In this method, water is supplied in the form of drops through nassals. water can be saved upto 70%.

Springler Method

It is the simplest and easiest method of all. In this method, water is supplied to the field from the source through the pipes with have small holes. It can be used in the areas of uneven surface also.

Rain Gun

Rain gun is used to spread water like rain. It can be used to water the crops which grow upto 4 feet. It is useful to irrigate the crops like sugarcane and maize.

Central - Pivot Irrigation

It is also called water wheel and circle irrigation. It is a method of crop irrigation in which equipment roatates around a pivot and crops are watered with springlers.

Multipurpose River Valley Projects in India

Multipurpose river valley project are basically designed for the development of irrigation for agriculture and electricity through the construction of dams. Initially, dams were built only for storing rain water to prevent flooding but now it became multipurpose. Here, we are giving the list of important river-valley projects in India.

1. Almatti Dam

It is a hydroelectric project constructed on the river Krishna.

2. Baspa Hydro-Electric Project

It is the first Independent Power Producer (IPP) project after the Government of India liberalized the power policy by inviting private sector participation in setting up a hydropower project on "BOO" basis. It is located in Kinnaur district of Himachal Pradesh. It is the largest private hydroelectric project and has been built by Jaypee group. It is located on Baspa River, a tributary of the Satluj.

3. Beas Project
It is a joint venture of the governments of Punjab, Haryana and Rajasthan. It consists of two units: (i) Beas-Sutlej Link and (ii) Beas Dam at Pong. The project links the Beas and the Sutlej rivers in Punjab through 38.4 km of hills and valleys. The waters of the Beas were poured into the mighty Sutlej river on July 10, 1977 at the first-ever man-made confluence of the two major rivers at Slapper in Himachal in a mighty bid to augment the water resources of the Gobind Sagar Lake of the Bhakra-complex. This completed the Rs 380- crore dream which was realised in a period of only 12 years.

List of Towns situated on the Banks of River

4. Bhadra Reservoir Project
It is constructed across the river Bhadra which is in Karnataka.

5. Bhakra-Nangal
Project (Himachal Pradesh) Largest multipurpose project in India and the highest straight gravity dam in the world (225.5 m high) on the river Sutlej.

6. Chambal Valley Project
It is a joint undertaking by the Rajasthan and Madhya Pradesh governments. The Rana Pratap Dam at Bhata, 48 km from Kotah, was inaugurated on Feb 9, 1970. The project comprises construction of two other dams: Gandhi Sagar Dam in Madhya Pradesh and Jawahar Sagar (Kotah) Dam in Rajasthan.

7. Chamera Hydro-Electric Project
The 540 MW Chamera hydro-electric project on the Ravi river in Himachal Pradesh was implemented with Canadian credit offer of about Rs 335 crore.

8. Chukha Project
The 336 MW project is the most prestigious and largest in Bhutan. It has been completely built by India. The dam has been constructed on Wang Chu River. The project costed Rs 244 crore.

River Project Towards East (Bay of Bengal)

9. Damodar Valley Project (West Bengal and Bihar)
Principal object of this multipurpose scheme is to control the flowing of the Damodar which is notorious for its vagaries and destructiveness. It is designed on the lines of the Tennessee Valley Authority (T.V.A.) in U.S.A.

10. Dul-Hasti Hydro-Electric Project

The Rs. 1263 crore project is being built on river Chenab in Jammu and Kashmir. The foundation of the project was laid in September 1984. The project will consist of a power plant of 390 MW capacities. The power house will be located underground.

11. Dhauliganga Project
The Rs. 600 crore, 280 MW project is to be located on Dhauliganga River in Uttaranchal.

River Valley Projects of Peninsular India

12. Farakka Barrage
The basic aim of the Farakka Barrage is to preserve and maintain Calcutta port and to improve the navigability of the Hooghly river. It consists of a barrage across the Ganga at Farakka, another barrage at Jangipur across the Bhagirthi, a 39-km long feeder canal taking off from the right bank of the Ganga at Farakka and tailing into the Bhagirathi below the Jangipur barrage, and a road-cum-rail bridge have already been completed. Specially, the object of Farakka is to use about 40,000 cusecs of water out of the water stored in the dam to flush the Calcutta port which is getting silted up.

13. Gandak Project (Bihar and U.P)
This is a joint venture of India and Nepal as per agreement signed between the two governments on Dec 4, 1959. Bihar and Uttar Pradesh are the participating Indian States. Nepal would also derive irrigation and power benefits from this project.

14. Hirakud Project (Odisha)
It is the first of a chain of three Dams planned for harnessing the Mahanadi.

River Valley Projects of North - East India (Brahmaputra)

15. Idukki Hydro-Electric Project
It is a giant hydro-electric project of Kerala and one of the biggest in the country, constructed with Canadian assistance with an installed capacity of 390 MW in the first stage and 780 MW in the second stage. The project envisages to harness Periyar waters, has three major dams, the 169 m high Idukki arch dam across Periyar river, 138 m high Cheruthoni Dam across the tributary of Cheruthoni river and 99.9 m high Kulamavu Dam.

16. Jayakwadi Dam (Maharashtra)
The 10-km-long Jayakwadi dam on the Godavari is Maharashtra's largest irrigation project located near Paithan.

17. Kalpong Hydro-Electric Project
This is the first hydel power plant of Andaman and Nicobar Islands. The 5.25 MW project was commissioned on July 1, 2001. It is located near Kalara village of Diglipur Tehsil in North Andaman and has been built by National Hydel Power Corporation.

18. Kakrapara Project
It is situated on the Tapti near Kakrapara, 80 km upstream of Surat. The project is financed by the Gujarat Government.

19. Koel Karo Project

The project envisages construction of earthen dam across river south Koel at Basia in Bihar and another dam over north Karo at Lohajimi. The capacity will be 710 MW.

20. Kol Project
The 600 MW project is to be located on the Satluj, 6 km upstream of the Dehar Power House on the Beas-Satluj link project in Mandi district, Himachal Pradesh. Besides generating power, the dam will also serve as a check dam for the 1,050-MW Bhakra Dam and prolong its life by at least 10 years.

21. Kosi Project
This project will serve Bihar and Nepal. The Kosi rises in Nepal, passes through Bihar and joins the Ganges. The river is subject to heavy floods. Two dams are to be built across it.

22. Nagarjunasagar Project
This Project is a venture of Andhra Pradesh for utilizing water of the Krishna River. The Nagarjunasagar Dam was inaugurated on Aug 4, 1967. It is situated near Nandikonda village in Miryalguda Taluk of Nalgonda district.

23. Nathpa-Jhakri Hydro-Electric Project
India's largest hydro-electric project, it is located at Nathpa Jhakri in Himachal Pradesh. It is built on Satluj River. The first of the six 250 MW units was commissioned on December 30, 2002. The project is being executed by Satluj Jal Nigam (formerly Nathpa Jhakri Power Corporation).

River Valley Projects of River Ganga

24. Parambikulam Aliyar Project
It is a joint venture of Tamil Nadu and Kerala States. It envisages construction of seven inter-connected reservoirs by harnessing rivers including two major rivers viz., Parambikulam on the western slopes of Annamalai Hills and Aliyar on the eastern slopes.

25. Parappalar Dam
The Rs 1-crore Parappalar Dam with a storage capacity of 167 million cubic feet near Oddenchatram, about 75 km from Madurai in Palni taluk (Tamil Nadu), was inaugurated on August 30, 1976.

26. Parvati Valley Project
It is the first inter-State hydel power project of India. Gujarat, Rajasthan, Haryana and Delhi have joined hands with Himachal Pradesh to set up the project. The 2050 MW project will be built near Kullu, on Parvati river, a tributary of Beas.

27. Periyar Valley Scheme (Kerala)
The scheme envisages the construction of a masonry barrage 210.92 metres long across the river Periyar near Alwaye, in Ernakulam district.

28. Rajasthan Canal Project
It is a bold venture of bringing irrigation to a desert area. The project, which uses water from the Pong dam, consists of 215-km long Rajasthan feeder canal (with the first 178 km in

Punjab and Haryana and the remaining 37 km in Rajasthan) and the 467-km long Rajasthan main canal lying entirely in Rajasthan.

29. Ramganga River Project
This Project in Uttaranchal envisages construction of a dam across the river Ramganga, one of the major tributaries of the Ganga at 3.2 km upstream of Kalagarh in Garhwal district. RANJIT SAGAR DAM PROJECT Formerly known as Thein dam, it was dedicated to the nation on March 4, 2001. It is built on the Ravi River near Thein village in Punjab. Total installed capacity is 600 MW.

30. Rihand Project (Mirzapur District—U.P)
This project has been completed by the U.P. Government and comprises the construction of a concrete gravity dam across the Rihand River in Mirzapur District (U.P.) and a Power House at Pipri and necessary transmission lines. Gobind Ballabh Pant Sagar is a part of this project.

31. Rongtong Project World's Highest Hydro Power Project
It is ringtone project that is situated in Kazan in the Spiti Valley in Himachal Pradesh. The project has helped transform the entire cold mountain desert into a lush greenbelt.

32. Salal Project
It has been built on River Chenab in Jammu and Kashmir. The first stage was completed on February 9, 1989 and marked the beginning of the harnessing of hydro power potential of river Chenab. At present the capacity of the powerhouse is 345 MW. With the completion of the second stage the capacity will double.

33. Sankosh Hydel-Power Project
India and Bhutan have signed an agreement for building of a gigantic Sankosh hydel power project. It will be one among the ten largest projects in Asia. The project is to be constructed near Kerabari in Gaylegphug district of Bhutan on Sankosh River. It will include a 600 metre-long and 239 metre high dam and a reservoir with a catchment area of 10,525 sq km. It is estimated to cost around Rs 2000 crore. Once completed, the project will generate 1,525 MW of power and help irrigate eight lakh hectares of land.

34. Sanjay Vidyut (Hydel) Project
It is Asia's first fully underground Hydel Project. The 120 MW project is located near Bhaba Nagar in Kinnaur district of Himachal Pradesh. It harnesses the water of the Bhaba Khud, a tributary of the Satluj.

35. Sardar Sarovar Project
It is one of the largest river valley schemes in the country. The project envisages construction of 163-metre-high cement concrete dam at Navagam in Gujarat. This will create irrigation potential of 1.79 million hectares and generate 1450 MW of power.

Drainage System in India

36. Sawalkote Hydro Project
The 600 MW project in Jammu & Kashmir is being built by a Norwegian consortium.

37. Sharavati Project (Karnataka)

It is located 400 km from Bangalore near the Gersoppa falls; the Sharavati Project is one of the world's major power projects, built by Indian engineers with American collaboration.

38. Srisailarn Project
It is a massive power project, 110 km away from Nagarjunasagar in the upper reaches of the river Krishna.

39. Subarnarekha Project
It is Rs 130-crore multipurpose project, which would, when completed, provide assured irrigation to 7,06,000 acres to the chronically drought-prone areas of Orissa and Bihar.

40. Tehri Dam Project
The World's fifth and Asia's largest hydroelectric project has been constructed on river Bhagirithi, a tributary of Ganga in Tehri district of Uttaranchal. The height of the earth and rockfill dam is 260.5 m, making it the highest dam in the country. Once fully operational, the project will produce 1000 MW electricity.

41. Tungabhadra Project (Andhra And Karnataka)
It is a joint undertaking by the governments of Andhra Pradesh and Karnataka. The project comprises a dam across the Tungabhadra River near Mallapuram.

42. Ukai Project
It is a power project of Gujarat equipped with power generating sets manufactured by Bharat Heavy Electricals Limited was inaugurated on October 12, 1977. It has added a 540,000 KW of installed capacity to the State's existing power network.

Agriculture

Agriculture is the process of producing food for people, fodder for cattle, fiber and many other desired products by the cultivation of certain plants and the raising of domesticated animals (livestock).

Determinants of Agriculture
Agriculture in India is determined by a set of factors. Some of the important factors:

1. Physical factors: relief, climate and soil.
2. Institutional factors: Size of farm holdings, land tenure, and land reforms.
3. Infrastructural factors: Irrigation, power, transport, credit, market, insurance and storage facilities.
4. Technological factors: High yielding varieties of seeds, chemical fertilisers, insecticides and machinery.

Types of Farming

a) Subsistence Farming
A considerable proportion of farmers in the country practice subsistence farming. Farmers grow crops with the help of family members and consumes almost the entire farm produce with little surplus to sell in the market. Preference is given to food crops. In addition to the food crops, sugarcane, oilseeds, cotton, jute and tobacco are also cultivated. Traditional farming method results in low productivity.

b) Shifting Agriculture

This type of agriculture is performed by tribal people in a piece of forest land after clearing the trees through felling and burning the trunks and branches. Once the land is cleared, crops are grown for two to three years and the land will get abandoned as the fertility of the soil decreases. The farmers then move to new areas and the process will be repeated. They cultivate some grains and vegetable crops using the manual labour. It is also called as "Slash and burn" cultivation.

c) Intensive Farming

Intensive farming is an agricultural intensification and mechanization system that aims to maximize yields from available land through various means, such as heavy use of pesticides and chemical fertilizers.

d) Dry Farming

This type of farming is practiced in arid areas where irrigation facilities are lacking. Crops cultivated in these areas can withstand dry conditions. The crops grown generally with the help of irrigation are also grown under dry farming. In such circumstances, the yields are generally low. Most of the areas under dry cultivation entertain only one crop per year.

e) Mixed Farming

Mixed farming is defined as a system of farm which includes crop production, raising livestock, poultry, fisheries, bee keeping etc. to sustain and satisfy as many needs of the farmer as possible.

f) Terrace Farming

This type of cultivation is practiced specially in hilly areas, where lands are of sloping nature. The hill and mountain slopes are cut to form terraces and the land is used in the same way as in permanent agriculture. Since the availability of flat land is limited, terraces are made to provide small patches of level land. Soil erosion is also checked due to terrace formation on hill slopes.

Major Crops Cultivated in India

The major crops of India are divided into four major categories as follows:

1. Food crops (wheat, maize, rice, millets, pulses etc.).
2. Cash crops (sugarcane, tobacco, cotton, jute, oilseeds etc.).
3. Plantation crops (tea, coffee and rubber).
4. Horticulture crops (fruits, flowers and vegetables).

1. Food Crops

Due to its large population, Indian agriculture is largely dominated by the food crops.

Rice

DISTRIBUTION AND PRODUCTION OF RICE IN INDIA

Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. This is the staple food of the people living in the eastern and the southern parts of the country, particularly in the areas having over 150 cm annual rainfall.

Conditions of Growth of Rice

Rice is grown almost throughout the year in hot and humid regions of eastern and southern parts of India where two to three crops are grown in a year. But in the northern and hilly parts of the country, the winters are too cold for rice cultivation and only one crop is grown in those areas.

Rice is grown under varying conditions in India from 8°N to 30°N latitude and from sea level to about 2,500 metre altitude.
It is a tropical plant and requires high heat and high humidity for its successful growth.

The temperature should be fairly high at mean monthly of 24°C. It should be 20°-22°C at the time of sowing, 23-25°C during growth and 25°-30°C at the harvesting time.

T'he average annual rainfall required for rice is 150 cm. It is the dominant crop in areas of over 200 cm annual rainfall and is still an important crop in areas of 100-200 cm rainfall. The 100 cm isohyet forms the limit of rice in rainfed areas. In areas receiving less than 100 cm annual rainfall, rice can be grown with the help of irrigation. About 40 percent of rice crop in India is raised under irrigation. Lesser amount of rainfall is required as the harvesting time approaches. The fields must be flooded under 10-12 cm deep water at the time of sowing and during early stages of growth

Therefore, the fields must be level and have low mud walls to retain water. This peculiar requirement of rice makes it primarily a crop of plain areas. Rice grown in well watered lowland plain areas is called wet or lowland rice.

In hilly areas, the hill slopes are cut into terraces for the cultivation of rice. Such a cultivation in which the hill slopes are cut into terraces is called terraced cultivation. The supply of water to the hill terraces is not as much as in the plain areas and the rice grown in hilly areas is called dry or upland rice.
Rice can be grown on a variety of soils including silts, loams and gravels and can tolerate acidic as well as alkaline soils. Black lava soil is also useful for rice cultivation.

Rice crop is not much suited to mechanization and therefore requires large supply of cheap labour for its successful cultivation.

According to G.B. Cressey rice needs plenty of heat, plenty of rain, plenty of alluvium and plenty of labour to provide plenty of food for plenty of people. There is no other food crop which is so plentiful as rice in India.

Production of Rice

India is the second largest producer and consumer of rice in the world after China and accounts for 17.95 percent of the world's total rice production. There has been considerable increase in production, area and yield of rice in India.

There was a record production of 106.3 million tonnes in 2013-14. Yield also reached at a high level of 2,419 kg/hectare but still much lower as compared to China, USA and Japan. This means that there is still vast scope for increasing production. This will have to be done by increasing yields because scope for increasing area under no crop is negligibly small.

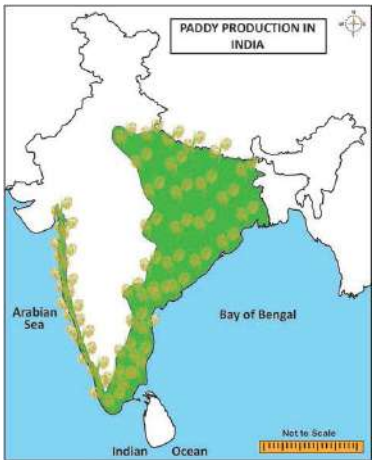
Distribution of Rice

Rice is grown in varying degrees in almost all parts of the country except higher parts of the Himalayan ranges exceeding 2,500 metres in altitude, Marusthali part of Rajasthan, KachchhSaurashtra, Malwa and Marathwada regions due to various geographical constraints.

Rice producing areas mainly include the lower and the middle Ganga Plains, the east and the west Coastal Plains, the Brahmaputra valley and parts of the Peninsular plateau.

Punjab, Haryana and Uttar Pradesh have assumed considerable importance after the introduction of the Green Revolution.

It is clear that about half of rice production in India is contributed by four states namely West• Bengal, Uttar Pradesh, Punjab and Andhra Pradesh. The other major producers are Odisha, Bihar, Chhattisgarh, Assam, Tamil Nadu, Haryana, Karnataka, Jharkhand, Madhya Pradesh, Maharashtra, Gujarat and Kerala in order of importance.



Wheat

Wheat (Triticum aestivum L.) is the second most important cereal crop of India and plays a vital role in food and nutritional security of the country. Nearly 55 per cent of the world population depends on wheat for about 20 per cent of calories intake. It is one of the major food grains of the country and a staple food of the people of North India, where people have preference for chapatti. The diverse environmental conditions and food habits of people in India supports the cultivation of three types of wheat (bread, durum and dicoccum). Among these, bread wheat is contributing approximately 95 per cent to total production while another 04 per cent comes from durum wheat and close to one per cent from Dicoccum. Wheat crop in India is grown under six diverse agro-climatic zones (Table 1), wherein IndoGangetic Plains (IGPs) comprising the two zones namely; North Western Plains Zone (NWPZ) and the North Eastern Plains Zone (NEPZ) form the major wheat tract followed by the Central Zone (CZ) and the Peninsular Zone (PZ).

Table 1. Classification of wheat growing zones in India

Zone	Region/State	Area (m. ha)
Northern Hills Zone (NHZ)	Western Himalayan regions of J&K (except Jammu and Kathua distt.); H.P. (except Una and Paonta Valley); Uttaranchal (except Tarai area); Sikkim and hills of West Bengal and N.E. States	0.9
Wheat Cultivation in India North Western Plains Zone (NWPZ)	Punjab, Haryana, Delhi, Rajasthan (except Kota and Udaipur divisions) and Western UP (except Jhansi division), parts of J&K (Jammu and Kathua distt.) and parts of HP (Una distt. and Paonta valley) and Uttarakhand (Tarai region)	11.5
North Eastern Plains Zone (NEPZ)	Eastern UP, Bihar, Jharkhand, Odisha, West Bengal, Assam and plains of NE States	11.9
Central	Madhya Pradesh, Chhattisgarh, Gujarat, Kota and Udaipur	5.0

Zone (CZ)	divisions of Rajasthan and Jhansi division of Uttar Pradesh	
Peninsular Zone (PZ)	Maharashtra, Karnataka, Andhra Pradesh, Goa and plains of Tamil Nadu	1.8
Southern Hills Zone (SHZ)	Hilly areas of Tamil Nadu and Kerala comprising the Nilgiri and Palni hills of southern plateau	0.1
	Total	31.2

This classification of zones has been based on climatic conditions, soil types and growing duration of wheat. During wheat growing season, the expected changes in climatic factors viz; precipitation/winter rains, minimum and maximum temperature, wind velocity and its direction, sunshine hours etc. need to be considered in choosing modern varieties and matching production and protection technologies that are developed specifically to mitigate the possible anticipated effects of climate change.

Cash Crops

The crops which are cultivated for commercial purpose are called cash crops. These crops include sugarcane, tobacco, fibre crops (cotton, jute, and mesta) and oilseeds.

Cotton

Cotton is one of the most important fiber and cash crop of India and plays a dominant role in the industrial and agricultural economy of the country. . India ranks second next to China in the production of cotton. It provides the basic raw material (cotton fibre) to cotton textile industry. Cotton in India provides direct livelihood to 6 million farmers and about 40 -50 million people are employed in cotton trade and its processing.

Climate & Soil Requirement

Cotton, a semi-xerophyte, is grown in tropical & sub tropical conditions. A minimum temperature of 15oC is required for better germination at field conditions. The optimum temperature for vegetative growth is 21-27oC & it can tolerate temperature to the extent of 43oC but temperature below 21oC is detrimental to the crop. Warm days of cool nights with large diurnal variations during the period of fruiting are conducive to good boll & fibre development.

Cotton is grown on a variety of soils ranging from well drained deep alluvial soils in the north to black clayey soils of varying depth in central region and in black and mixed black and red soils in south zone. Cotton is semi-tolerant to salinity and sensitive to water logging and thus prefers well drained soils.

Area and distribution

Cotton is one of the most important commercial crops playing key role in economic, political and social affairs of the world chiefly as fibre crop. Cotton is cultivated in about 60 countries of the world but 10 countries viz., Russia, USA, China, India, Brazil, Pakistan, Turkey, Egypt, Mexico and Sudan account for about 85 % of the total production. It is cultivated in an area of about 32.9 million hectres with a total production of 41.1 million tones of seed cotton.

India ranks first in the world in respect of acreage with about 8 million hectares under cotton and fourth in total seed cotton production (80 lakhs bales - 170 kg lint contains 1 bale).

In India, cotton is cultivated on large scale in the states of Maharashtra, Gujarat, Karnataka, Madhya Pradesh, Punjab, Rajasthan, Haryana, Tamil Nadu and Uttar Pradesh. Gujarat is the largest producer of cotton in India followed by Punjab and Maharashtra.

In Gujarat, cotton is cultivated in about 15.19 lakh hectares with an annual production of about 31.80 lakh bales of cotton (lint). In Gujarat, it is widely cultivated in almost all districts except part of Dangs and Valsad districts.

Jute

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

Conditions of Growth:

Jute is the crop of hot and humid climate. It requires high temperature varying from 24°C to 35°C and heavy rainfall of 120 to 150 cm with 80 to 90 per cent relative humidity during the period of its growth Small amount of pre-monsoon rainfall varying from 25 cm to 55 cm is very useful because it helps in the proper growth of the plant till the arrival of the proper monsoon. Incessant and untimely rainfalls as well as prolonged droughts are detrimental to this crop. Rainfall between 2.5 to 7.5 cm in a month, during the sowing period, is considered to be sufficient.

Occasional showers varying from 2 to 3 cm at intervals of a week's time during the growing period are very useful. Large quantity of water is required not only for growing the jute crop but also for processing the fibre after the crop is harvested.

Light sandy or clayey loams are considered to be best suited soils for jute. Since jute rapidly exhausts the fertility of soil, it is necessary that the soil is replenished annually by the silt-laden flood water of the rivers. Large supply of cheap labour is also necessary for growing and processing the jute fibre.

Method of Cultivating and Processing of Jute:

Jute is generally sown in February on lowlands and in March-May on uplands. The crop takes 8- 10 months to mature but different varieties take different time to mature. The harvesting period generally starts in July and continues till October.

Production:

India suffered a great setback in the production of jute as a result of partition of the country in 1947 because about 75 per cent of the jute producing areas went to Bangladesh (East Pakistan at that time) Fortunately, most of the jute mills remained in India. Strenuous efforts were made to increase production and area of jute, immediately after partition to feed our starving jute mills in the wake of short supply of raw jute.

Distribution:

1. West Bengal:

West Bengal is the undisputed king of jute production in India accounting for over four-fifths of the production and nearly three-fourths of the area under jute. Here hot and humid climate and alluvial, loamy soil coupled with cheap abundant labour provide the par excellence conditions for the growth of jute.

Almost all parts of the state are producing some jute but its cultivation decreases in the north sub-Himalayan region, towards the south in the Ganga delta where land is too low for jute and towards the west where the rocky ground of the Deccan plateau is more marked than the Ganga alluvium.

However, major part of the production comes from Nadia, Murshidabad, 24 Parganas, Coochbehar, Jalpaiguri, Hugli, West Dinajpur, Bardhaman, Maldah and Medinipur districts. The entire jute production is consumed in the jute mills located in the Hugli basin. In 2002-03, West Bengal produced 85.06 lakh bales of jute.

2. Bihar:

Bihar is the second largest producer but lagging far behind West Bengal in the production of jute accounting only for about 9.72 per cent of the production and over 17 per cent of the area of the country under jute. Purnea is the largest producing district accounting for 60 per cent of Bihar s production. Katihar, Saharsa and Darbhanga are the other producing districts.

3. Assam:

With about 6.68 per cent of the production and 7.88 per cent of the area of the country, Assam is the third largest jute producing state of India. The main concentration is in the Brahmaputra and Surma valleys. Goalpara, Kamrup, Nowgong, Darrang and Sibsagar are the main producing districts.

Others:

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

Trade:

India's production of jute always falls short of her requirements and it is imported to feed our jute mills. Bangladesh is the chief supplier of jute to India. There are year to year fluctuations in the quantity and value of jute imported by India. In 2003-04, India imported 111.9 thousand tonnes of jute worth Rs. 94 crore.

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

Sugarcane

Sugarcane belongs to bamboo family of plants and is indigenous to India. It is the main source of sugar, gur and khandsari. About two-thirds of the total sugarcane produced in India is consumed for making gur and khandsari and only one third of it goes to sugar factories. It also provides raw material for manufacturing alcohol.

Bagasse, the crushed cane residue, can be more beneficially used for manufacturing paper instead of using it as fuel in the mills. It is also an efficient substitute for petroleum products and a host of other chemical products.

A part of it is also used as fodder. Sugarcane accounts for the largest value of production and holds an enviable position among all the commercial crops in India. Obviously, it is the first choice of the farmers, wherever geographical conditions favour its growth.

Conditions of Growth:

It is a long duration crop and requires 10 to 15 and even 18 months to mature, depending upon the geographical conditions. It requires hot and humid climate with average temperature of 21°-27°C and 75-150 cm rainfall.

In the latter half, temperature above 20°C combined with open sky helps in acquiring juice and its thickening. Too heavy rainfall results in low sugar content and deficiency in rainfall produces fibrous crop. Irrigation is required in areas receiving lesser rainfall than the prescribed limit. Short cool dry winter season during ripening and harvesting is ideal.

Frost is detrimental to sugarcane. Therefore, it must be harvested before frost season, if it is grown in northern parts of the country where winters are very cold and frost is a common phenomenon. On the other hand, hot dry winds are also inimical to sugarcane.

It can grow on a variety of soils including loams, clayey loams, black cotton soils, brown or reddish loams and even laterites. In fact, sugarcane can tolerate any kind of soil that can retain moisture. But deep rich loamy soils are ideal for its growth.

The soil should be rich in nitrogen, calcium and phosphorus but it should not be either too acidic or too alkaline. Sugarcane exhausts the fertility of the soil quickly and extensively and its cultivation requires heavy dose of manures and fertilizers.-Flat plain or level plateau is an advantage for sugarcane cultivation because it facilitates irrigation and transportation of cane to the sugar mills.

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

Distribution:

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

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

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

(iii) Coastal Andhra and the Krishna Valley.

Here, it is worth drawing a comparison between sugarcane cultivation in the northern and the southern parts of India. In northern plain of India, the summer temperatures ranging from 30° to 35°C and dry scorching winds called 'loo' in May and June hamper the normal growth of the cane.

In the winter months of December and January the sugarcane crop is likely to be damaged by excessively cold weather accompanied by frost. Consequently the yield/hectare is low. In south India, on the other hand, the absence of 'loo' during the summer and reasonably high temperature during the frost free winter, coupled with the maritime winds in the coastal areas are some of the climatic factors which are extremely beneficial to this crop.

The paradoxical character of sugarcane cultivation in India is that whereas south India offers more favourable climatic conditions for the growth of sugarcane, the most important sugarcane belt lies in north India. There are two reasons for such a contradictory situation.

Before the World War I, this area was mainly used for growing indigo which was the most favourite cash crop with the farmers at that time. But with the introduction of cheap aniline dyes, indigo lost its market and its cultivation had to be discontinued after the First World War.

Consequently, its place was taken by sugarcane cultivation. Another reason is that sugarcane has to face tough competition for land from a number of other cash crops such as cotton, tobacco, groundnut, coconut, etc. in the south.

Oilseeds

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

Groundnut

Groundnut is most important oil seeds of India accounting for half of the major oilseeds produced in the country. Groundnut is predominantly a Kharif crop but is also sown as a Rabi crop. 90-95% of the total area is devoted to kharif crop. It is a legume which thrives best in tropical climate and requires 20°C to 30°C temperature; 50-75 cm rainfall. The crop is highly

susceptible to frost, drought, continuous rain and stagnant water. It needs dry winder at the time of ripening. Well drained light sandy loams, red, yellow and black soils are well suited for its cultivation. In 2015-16, the top three states producing ground nut were Gujarat, Rajasthan and Tamil Nadu.

Rapeseed / Mustard

Mustard is second most important oil seed crop of India after Groundnut. This planet belongs to cabbage family (Brassica) and farmers in India mainly grow three species of Mustard as follows:

- India Mustard (Rai / Mohr locally) (Botanical name – *Brassica juncea*) has small and reddish brown seeds and accounts for around 70% of total mustard production in India.
- Mustard or Peeli (Yellow) Sarson (*Brassica campestric*) has thicker pods and yellowish brown seeds with thin seed coats.
- Rape Seed or Toria (*Brassica napus*) has reddish seeds and is mainly grown in Punjab.

Mustard seeds have 25-45% oil content and its oil cake makes an important cattle feed and manure. The plant thrives in north and west India, mainly Satluj-Ganga plain. Its generally grown as a Rabi crop either purely or as mixed cropping with wheat or gram or barley. India has largest area and highest production of mustard. Currently, Rajasthan is top Mustard producing state of India, followed by Haryana and MP.

Sesamum (Til)

The Sesamum seed comprises of 45 to 50 per cent oil used for cooking purposes and for manufacturing perfumery and medicines. India has the world's largest area under Sesamum and is also the largest producer of this crop accounting for one-third of the world production. Its mainly a Rainfed crop in India.

Linseed:

Linseed (Alsi in Hindi) has a unique drying property and is suitable for manufacturing of paints, varnishes, printing ink etc. A small part is used as edible oil also.

Castor Seed

Castor seed comprises 50 per cent oil. It is mostly used in industries.

Palm Oil

India produces a very small fraction of palm oil but is one of the largest consumers. Most of India's palm oil requirement is met by imports from Indonesia and Malaysia.

Trade:

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

Plantation Crops

Plantation crops are cultivated for the purpose of exports. These are cultivated in large estates on hilly slopes. Tea, coffee, rubber and spices are the major plantation crops of India.

TEA

An intrinsic part of daily life today, tea was introduced formally to Indians by the British. The origin of tea in India is owed to the British who intended to overthrow China's monopoly on tea, having found that Indian soil was eminently suitable to cultivate these plants. The evidence of local plants was a great indication that the soil was right for transplanting Chinese seedlings and it was the Assam valley and the looming mountains of Darjeeling that were chosen as early sites for tea planting. After many unsuccessful attempts over 14 long years, tea production in India began to boom, enabling the production of a tea that was equal, if not better, than its Chinese counterpart. Thanks to them, India became, and remains, one of the largest tea producers in the world – second only to China.

Let's explore the history of tea in India, one of the world's largest producer of tea. Commercial tea plantations were first established under the British Rule when a native variety of Camellia sinensis plant was discovered by Scotsman Robert Bruce in 1823 in Assam. The story goes that a local merchant, Maniram Dewan, introduced Bruce to the Singpho people who were drinking something very similar to tea. The Singphos plucked the tender leaves of a wild plant and dried them under the sun. These leaves were also exposed to the night dew for three whole days after which they would be placed inside the hollow of a bamboo tube and smoked till flavors developed. Bruce sampled the leaf decoction and found it to be similar to the tea from China.

Bruce collected samples of this plant. But it was only after his demise in 1830 that his brother Charles pursued the interest and sent samples for testing to Calcutta. It was found to be tea but a variety different from the Chinese plant and was named Assamica.

It is significant to note that during the time that these developments took shape, efforts were being made by the East India Company to break the Chinese monopoly over global tea trade due to their rising conflict of interests. One of the initiatives taken by the Company in lieu of this situation was to start producing tea within the British colonies, including India. For this, Chinese tea seeds were reportedly smuggled into the colonies, including India and Sri Lanka, and tested for commercial viability. However, these Chinese plants were unsuitable to Assamese terroir. So the Assamica variant was welcomed. After many trials and extended periods of dedicated efforts, the first British-led commercial **tea plantation in India** was established in 1837 in Chabua in Upper Assam.

The tea industry in India started to take shape around early 1840. Chinary tea plants, which were first tried out in Assam, were later tested in high-elevation regions of Darjeeling and Kangra, and it was here that they grew far more healthily. Tea planting in Darjeeling officially began in 1841, when the first superintendent of Darjeeling, Archibald Campbell, experimented by planting a few chinary tea seeds near his house. Many others began experimenting with tea in much the same way, and by 1847, an official tea plant nursery was established in Darjeeling. Soon after, the first commercial plantation was established with the setting up of Tukvar Tea Estate in Darjeeling in 1850.

The tea industry in India today

The tea industry did not end when the British left India. In fact, the tea market in India has been growing ever since. Today, there are as many as 43,293 tea gardens across the whole of Assam, 62,213 tea gardens in the Nilgiris and only 85 tea gardens in Darjeeling (*source: Tea Board of India)*. In order to ensure the supply of genuine Darjeeling, Assam and Nilgiri tea, a compulsory system of

certifying the authenticity of these teas was incorporated into the Tea Act of 1953. The words 'Darjeeling', 'Darjeeling logo', 'Assam logo' and 'Nilgiri logo' are registered under the Geographical Indications of Goods Act of 1999.

Tea drinking itself has evolved in many ways, with every region of this vast country making their own chai variants. There are humble roadside *chaiwallas* making hundreds of steaming cups that connect all strata of society, and on the other end of the spectrum are the gourmet stores that sell and serve fine Indian tea.

Coffee

Coffee is prepared from the roasted seeds called as Coffee beans. Coffee is grown in more than 70 countries of the world. Due to Caffeine, it gives stimulating effects. It originated in Ethiopia and its cultivation expanded from the Arab world to other parts of the world.

About Coffee Plant

Taxonomically, Coffee plant belongs to Rubiaceae family. *The plant is* an evergreen shrub. The flowers bloom simultaneously and are followed by oval berries of about 1.5 cm. The berries are Green when immature, ripen to yellow and get crimson before they get black on drying. Berries ripen in seven to nine months. Coffee is generally propagated by vegetative methods just to maintain the new strains. Cuttings, grafting, and budding are the usual methods of vegetative propagation. However, Coffee can be grown by seeds as well. The traditional method of planting coffee is to put 20 seeds in each hole at the beginning of the rainy season, out of which half are eliminated naturally.

- Coffee needs hot and humid climate with temperature varying between 15°C and 28°C. It is generally grown under shady trees.
- Strong sun shine, high temperature above 30°C, frost and snowfall are harmful for coffee cultivation.
- Dry weather is necessary at the time of ripening of berries
- Rainfall between 150 to 250 cm is favourable for coffee cultivation.
- Well drained, rich friable loamy soil with humus and minerals are ideal for coffee cultivation.
- Coffee also needs cheap and skilled labour.

Important Varieties

There are more than 100 species of coffee but only a few are grown commercially. In our country *Coffea robusta* (or Coffea canephora) and *Coffea arabica are grown*.

Robusta Coffee

Robusta Coffee or *Coffea canephora* is mostly grown in Africa and Brazil but also grown in South Asia and South East Asia. On the account of this coffee only, Vietnam has become one of the largest producers and exporter of coffee in the world. Though, it is considered inferior to Coffea arabica, it requires lesser care. It has twice amount of caffeine than Arabica.

Coffea Arabica

Coffea arabica is indigenous to Ethiopia and Arab world. It is also known as Coffee Shrub of Arabia and is believed to be the first variety of Coffee to be cultivated. It naturally contains little caffeine.

Coffea liberica

Coffea liberica is a species that originated in Liberia. The plant grows up to 9 meters and produces larger cherries. Its variety Baraco is a major crop in Philippines.

Coffea charrieriana

Coffea charrieriana is a coffee that is free of caffeine. It is found in Cameroon.

Mocha Coffee

Mocha Coffee or Cafe mocha is derived from Coffea Arabica. This name derived from the Mocha town of Yemen. Yemen was the largest producer and exporter of Mocha Coffee in some 15th and 16th century.

- India is 6th largest coffee producer in the world with 4% share after Brazil, Vietnam, Colombia, Indonesia and Ethiopia.
- In India, coffee is cultivated in about 4.54 lakh hectares by 3.66 lakh coffee farmers and 98% of them are small farmers.
- Karnataka (54%), Kerala (19%) and Tamil Nadu (8%) are largest coffee producing states.
- India accounts for only 4-5% of world's coffee output, but exports 70-80% of its produce.
- Italy, Russia and Germany are the top three buyers of Indian coffee.
- In India, two coffee varieties robusta (or Coffea canephora) and Coffea arabica are grown on large scale.

Green Revolution

Green Revolution refers to the development of **high yielding variety (HYV)** seeds during the decade of 1960's which led to the phenomenal rise in the output of food crops in India. **Norman-e-Borlaug** is considered as the father of Green Revolution in World while **M.S. Swaminathan** is considered as the father of Green Revolution in India. Although the seeds of the green revolution were shown in the early 1950's in Mexico, the term Green Revolution was coined by **William S. Gadd** in 1968.

Timeline

1961- Intensive Agriculture Development Program(IADP), which focussed upon diffusing technical know-how, credit and Agricultural Technology in the selected district in a pilot mode, made the way for Green Revolution in India.

1966- The **High Yielding Varieties (HYVP) program** was introduced in the **Kharif Season of 1966**.

2002- Govt of India proposed **the 2nd Green Revolution**, with the inclusion of Genetically Engineered crops.

2005-06- National Horticulture Mission to enhance the production of fruit, vegetables, spices, flowers etc. were introduced.

2010-11- Bringing Green Revolution to Eastern India (**BGREI**).

Components of Green Revolution

The HYV Seeds

- HYV has increased **responsiveness to Chemical Fertilizers**, their period of maturing is short which enables the farmer to go for multiple cropping.
- For example, the new seeds of the Rice and Wheat take around **100 and 110 days** respectively, contrary to this the traditional varieties of wheat and rice take around 130 and 150 days respectively to harvest.
- HYV seeds help in **generating more employment** since under optimum conditions they require more labour per unit area.

Irrigation

- It is the second most important component of Green Revolution after HYV, and **over and under-irrigation, both are injurious** to the crop.
- As Indian rainfall is unreliable, irregular and seasonal, there is an urgent need to expand irrigation potential.

- The timing of irrigation and quantity of water supplied are important for the satisfactory performance of the crop, as in case of wheat appropriate timing and spacing of irrigation raise the yield as much as 50%, even if other inputs like fertiliser etc are not applied.

Chemical Fertilizers

- The natural fertility of the soil decreases over the period of time and HYV seeds are also known as hungry varieties, which require a high dose of fertilizers to give high yields.
- In terms of fertiliser consumption till 1970, southern India was leading, later Northern India particularly, Punjab, Haryana and Uttar Pradesh became the main consumers.

Insecticide and Pesticide

- The monoculture promoted by the Green Revolution is more vulnerable to insects and pests, thus use of Pesticide and Germicide becomes compulsory for secured yields.

Consolidation of Holding

- Small and fragmented landholding has been the main problem in the progress of agriculture in India.

Land Reforms

- Under zamindari system zamindars used to exploit the farmers, thus after independence reform where introduced and intermediaries like Zamindari system were abolished, further ceiling laws were imposed. One of the objectives of the land reform was **land to the tiller.**

Agriculture Credit

- The inputs like Technology, HYV Seeds, Fertilizer, Pesticide etc all depend on the availability of the credit.
- Easy and cheaper credit is a must.

Rural Electrification

- Electric power which is the nucleus of all technological development is imperative for multiple cropping and intensification of Agriculture.

Farm Mechanisation

- Mechanisation saves human labour and quickens the farm operations; thus, it improves the farm efficiency and productivity.

Agriculture Universities

- Agriculture universities and other institutes are primarily engaged in agriculture research and passing on the research finding to the farmers.

Positive Impacts of Green Revolution

1. **Increased Agriculture Production-** The production of wheat increased from around 24 Million tonnes in 1970-71 to around 96 Million tonnes in 2013-14, and the production of rice increased from around 31 Million tonnes in 1965-66 to around 106 Million tonnes in 2013-14.
2. **The prosperity of Farmers-** Earning of farmer increased with the increase in production.
3. **Reduction in the import of food-grains.**
4. **Dispersal of Rice and Wheat cultivation to non-traditional areas-** Green Revolution spread the Rice cultivation to the semi-arid areas of Punjab, Haryana and Western Uttar Pradesh, and the wheat cultivation has spread to the areas of Eastern Uttar Pradesh, Madhya Pradesh, Rajasthan and some parts of Maharashtra, Gujarat and West Bengal.

5. **Industrial Growth-** Due to the large-scale mechanisation which was brought by Green Revolution, demand for different types of machines like tractors, harvesters, combines etc increased and along with increased demand in fertilizers, insecticide, pesticide etc, the growth spurt in the industries producing these items.
6. **Rural Employment-** Large no. of farm labourer migrated from the areas like Eastern Uttar Pradesh, Bihar to Punjab, where they got better employment opportunities.

Negative Impacts of the Green Revolution

1. **Intercrop disparities**- Green Revolution has promoted **Monoculture** of some remunerative species and it is wheat which has benefitted most and sometimes people due to this very reason, term Green Revolution as **Wheat Revolution**. Green Revolution has snatched areas from crops like coarse cereals, pulses and oilseeds and at the same time, major commercial crops like Cotton, Jute, Sugarcane, Tea are also almost untouched by it.
2. **Regional Disparities**- According to some estimates Green Revolution benefitted only 40% of the total crop area and 60% is still untouched by it, this has given rise to regional disparities. The benefitted areas include Punjab, Haryana, Western UP in Northern India and Andhra Pradesh and Tamil Nadu in South India.
3. **Rise in interpersonal disparities**- Big farmers who own 10 hectares or more land, are benefitted most from the Green Revolution, as they have more financial resources to buy better seeds, fertilizers and other required inputs. Thus, the green revolution made rich richer and left the poor poorer, which resulted in widespread social and economic tensions.
4. **Unemployment**- Except in Punjab, and to some extent in Haryana, Green Revolution induced Farm Mechanisation has created widespread unemployment among the rural labourers.
5. Ecological problems like **Soli Salinity, Alkalinity, Waterlogging, Desertification, Soil Erosion.**
6. **Depletion of Underground Water**- As the canal irrigation is not sufficient in the semi-arid areas of Punjab, Haryana, Western Uttar Pradesh, to meet the irrigation demand farmer depend heavily on Tube well irrigation which had led to depletion of the level of groundwater in these areas.
7. **Deforestation**- Green Revolution heartland like Punjab and Haryana are almost devoid of the forest with around 3% of forest area in both while UP is having slightly more than 5% area under the forest.
8. **Environmental Pollution**- Indiscriminate use of chemicals has led to environmental pollution as some of the chemicals enter the water by getting dissolved in it and pollute both surface and groundwater. Moreover, the chemicals enter into the soil and destroy useful microorganisms.

Second Green Revolution

Due to the limitations of the first Green Revolution in increasing the production of pulses, oilseeds, fruits, and vegetables, which are very important for ensuring nutritional security, the second revolution was introduced. The focus of the first green revolution was on increasing the production of food grains without considering the environmental impacts of it while the second green revolution is committed towards sustainable agriculture.

The aim of 2nd Green Revolution are:

1. To enhance agricultural productivity to promote food security.
2. More focus on Bio-Technology.
3. To encourage sustainable Agriculture.
4. To increase the per capita income of farmers and raise their standard of living.

5. To become self-sufficient in staple food, pulses, oilseeds.

Strategies for the Second Green Revolution

1. **Micro-irrigation System-** It enables optimal synergies of 3 components of Green Revolution-improved seed, water and fertilizer.
2. **Organic Farming**
3. **Precision Farming-** It is concerned with using fewer resources and reducing the production cost, by analysing the variation in various aspects of field and environment like- weather, Soil, vegetation, water etc.
4. **Green Agriculture-** A system of agriculture based upon, integrated pest management, integrated nutrient management and it **does not eliminate the use of minimum quantities of fertilizer and chemical pesticides.**

Bringing Green Revolution to Eastern India

It is a sub-scheme under **Rashtriya Krishi Vikas Yojana (RKVY) (launched in 2010-11),** to improve the rice and wheat-based cropping system in the eastern states of India

BLUE REVOLUTION IN INDIA

Fish touch our lives in countless ways in terms of providing food, nutrition, recreation, livelihood, employment and many more. It comes mainly from two modes of production systems: Capture Fisheries (capturing wild fish from marine and freshwater) and Culture Fisheries (farming fish, also known as aquaculture). India is the second largest fish producing country in the world with an annual production of about 12.60 million metric tonnes; it is aimed to increase it to 15.00 million metric tonnes by 2020.

The National Fisheries Development Board (NFDB), established in 2006, is an autonomous organization under the administrative control of the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Govt. of India. It was set up to realize the untapped potential of fisheries sector in inland and marine fish capture and culture, processing and marketing of fish and accelerate the overall growth of fisheries sector with the application of modern technology backed by research & development. The primary role of NFDB, till recently, has been to channelize Govt. of India funds though activities such as identifying the needs of implementing agencies, providing technical guidance, monitoring physical and financial progress of projects, impact assessment, etc., that have remained as integral components. Nevertheless, NFDB has taken up numerous and multifarious developmental activities which have undoubtedly brought visible positive changes in production and productivity as well as post-harvest operations of the fisheries sector.

Vision

To develop fisheries and aquaculture in a big way by adopting new and innovative production technologies, management and utilization of unutilized water resources, establishment of adequate infrastructure for post harvest operations and proper market tie-ups.

Mission

Holistic development of the fisheries sector through enhancement of fish production and productivity, to supplement nutritious protein for the growing population, to accelerate the overall economy of the country, besides improving health, economy, exports, employment and tourism in the country.

Objective

•To provide focussed attention towards fisheries and aquaculture

• To achieve sustainable management and conservation of natural aquatic resources

• To apply modern tools of research and development for optimizing production and productivity from fisheries

• To provide modern mechanisms for effective fisheries management and optimum utilization

• To train and empower women in the fisheries sector and also generate substantial employment

• To enhance the contribution of the fish towards food and nutritional security.

To realise the objectives, the Dept. of Animal Husbandry, Dairying and Fisheries launched the Scheme "Blue Revolution: Integrated Development and Management of Fisheries" by merging all the ongoing schemes in fisheries sector. To remain relevant in the changing scenario, NFDB is also evolving itself to handle a gamut of proactive and pivotal responsibilities under Blue Revolution. NFDB is scrutinizing the proposals received from States/UTs under Blue Revolution and also gearing up to implement directly some key projects in emerging and innovative areas in fisheries, such as cage culture, quality seed production, value chain development, etc.

WHITE REVOLUTION IN INDIA

In India, milk is obtained from cows, buffaloes, goats and from camels (in Rajasthan). The Indian Dairy Industry has acquired substantial growth from the Eighth Plan onwards. India's milk output has not only placed the industry first in the world, but also represents sustained growth in the availability of milk and milk products. The dairy v sector is now the largest contributor in the agricultural sector to the nation's GDP. The huge increase in milk supply through concerted efforts on a cooperative level is known as the White Revolution.

Operation Flood:

Success in raising the milk production is ascribed to the Operation Flood project.

In 1965, the National Dairy Development Board (NDDB) was set up to promote, plan and organise dairy development through cooperatives. These cooperatives were envisaged as democratic institutions, owned and managed by rural producers and were sensitive to the producer's demands. Basically, Anand model of dairy development was to be replicated in other parts. These cooperatives were also to provide consultancy services and set up dairy plants on a turnkey basis.

The NDDB launched Operation Flood in 1970 with commodity gifts from the European Economic Community, which included skimmed milk powder and butter oil. Proceeds from the sale of these products were used to finance the operation. A multi-tiered cooperative structure was established under the operation with Primary Village Cooperative Societies at the base, District Unions at the district level, and State Federations at the state level and the National Cooperative Dairy Federation of India as the apex body for milk cooperative societies.

Operation Flood is considered to be the world's largest dairy development programme. Under this programme professionals were employed at every level, particularly in marketing and application, and science and technology. The central plank of the programme was to link the rural producers with urban consumers.

These cooperatives undertake procurement, testing, storage and transport of milk; production of a range of milk products; marketing of milk and milk products. They also provide support facilities like balanced cattle feed, health services, artificial insemination and veterinary treatment backed by research in production, processing and marketing. A brief survey of the phases of Operation Flood is given below.

Phase-l:

It started in July 1970 and ended in 1981. The objective was to set up dairy cooperatives in 18 milk sheds in ten states, so as to link them with the four best metropolitan markets of

Mumbai, Delhi, Kolkata and Chennai. By the end of Phase-l, there were 13,000 village dairy cooperatives covering 15 lakh farmer families.

Phase-2:

It covered the Sixth Plan period from 1981 to 1985. It was designed to build on the foundations of Phase-l and on the IDA assisted dairy development programmes in Karnataka, Rajasthan and Madhya Pradesh. By the end of Phase-2, there were 136 milk sheds, 34,500 village dairy cooperatives covering 36 lakh members.

Phase-3:

It started in 1985 and its emphasis was on consolidating the gains of the earlier phases by improving productivity and efficiency of the cooperative dairy sector and its institutional base for long term sustainability. This phase came to an end in April 1996. By September 1996, about 73,300 dairy cooperative societies had been organised in 170 milk sheds involving over 9.4 million farmer members.

Outstanding Results:

1. The milk production in India increased from a level of 17 MT in 1950- 51 to about 100.9 MT at the end of 2006-07, i.e. at the end of the Tenth Plan.

2. The per capita availability of milk increased to about 246 gm per day in 2006-07 from a level of 124 gm per day in 1950-51.

3. Imports of milk solids have ended. India has also started exporting milk powder to some countries now.

4. Dairy industry and infrastructure have been expanded and modernised. A Milk Grid has been activated to offset regional and seasonal imbalances in milk production. A stable structure is now present to protect against political instability.

5. About ten million small farmers in 70,000 villages are earning jointly an incremental income of more than Rs 2000 crore, and more than 60 per cent of the milk procurement for Operation Flood comes from small, marginal farmers and the landless.

6. Most of the dairy needs are met indigenously.

7. Genetic improvement of milch animals has been made possible by cross-breeding.

Problems of Dairy Industry in India:

1. Because of small holdings and scattered milk production, the collection and transportation of milk, in good quality, to markets is difficult. This leads to an inefficient utilisation of milk products.

2. Because of unhygienic production, handling conditions and high temperatures, the quality of milk is adversely affected.

3. Because of inadequate marketing facilities, most of the marketable surplus is sold in the form of ghee which is the least remunerative of all milk products.

4. Crude methods for milk collection and production are used, which have low productivity.

5. The Indian cows and buffaloes are generally low yielding and non-descript because of the lack of healthy cattle-feed and fodder, tropical heat and diseases. It has been observed that the milk production per animal is higher where balanced mixed farming is practised, and the best milch animals are found where there is prosperous agriculture, where fodder, cereal, oilseed byproducts and crop residue are available and where the pressure on land is comparatively lower.

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II-M.Sc

GEOGRAPHY OF INDIA

CODE –18KP3GELG3

UNIT V: Population, Transport and Trade: Population: Growth and distribution. Transport: National Highways, State Highways, Indian Railways, Airways- Domestic and International Airports, Trade: Imports, Exports, Balance of Trade- Liberalization- Globalization.

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GEOGRAPHY OF INDIA

UNIT-V: POPULATION,TRANSPORT & TRADE

POPULATION: GROWTH AND DISTRIBUTION

TRNSPORT: NATIONAL HIGHWAYS, STATE HIGHWAYS, INDIAN RAILWAYS, AIRWAYS- DOMESTIC AND INTERNATIONAL AIRPORTS

TRADE: IMPORTS, EXPORTS, BALANCE OF TRADE- LIBERALIZATION-GLOBALISATION.

POPULATION GROWTH IN INDIA

Population growth is the increase in the number of individuals in a population. The "population growth rate" is the rate at which the number of individuals in a population increases in a given time period. The population growth rate measures how fast the size of population is changing. It can be calculated with the help of following equation:

$$\text{Annual growth rate (\%)} = (P_2 - P_1/P_1 \times N) \times 100$$

Where P_1 = Population size of previous census.

P_2 = Population size of present census.

N = Number of years between the two census.

Census is the complete count of individuals in an area and is done after every 10 years. First official census of Indian population was of 1891-1901 A.D, while latest census was of 2001-2011 period.

The decadal growth (10 years) rate is a vital part of Census operations. This gives an overview of the percentage of total population growth in a particular decade. Hence, it is termed as "***Decadal Growth Rate".***

Factors Determining Growth Rate of Population:

1. Birth rate (Natality rate).

2. Total Fertility Rate

3. Death rate or Mortality rate

4. Number of female individuals in active reproductive age (usually between 15-44 years)

5. Emigration and Immigration.

PHASES OF POPULATION GROWTH RATE IN INDIA

Phase I : The period from 1901-1921 is referred to as a period of ***stagnant or stationary phase*** of growth of India's population, since in this period growth rate was very low, even recording a negative growth rate during 1911-1921. Both the birth rate and death rate were high keeping the rate of increase low.

- Poor health and medical services,
- Illiteracy of people and
- Inefficient distribution system of food and basic necessities were largely responsible for a high birth and death rates in this period.

Phase II: The decades 1921-1951 are referred to as the period of ***steady population growth***.

- An overall improvement in health and sanitation throughout the country brought down the mortality rate.

- Better transport and communication system improved distribution system.
- This phase growth is due to of Great Economic Depression, 1920s and World War II.

Phase III: The decades 1951-1981 are referred to as the period of ***population explosion*** in India, which was caused by a rapid fall in the mortality rate but a high fertility rate of population in the country. The average annual growth rate was as high as 2.2 per cent.

- After the Independence, developmental activities were introduced through Five Year Plans
- Economy started ensuring the improvement of living condition of people.
- Besides, increased international migration brought in Tibetans, Bangladeshis, Nepalies and even people from Pakistan and contributed to the high growth rate.

Phase IV: In the post 1981 till present, the growth rate of country's population though remained high, has started ***slowing down***.

- A downward trend of crude birth rate is held responsible for such a population growth.
- An increase in the mean age at marriage
- Improved quality of life
- Education of females in the country.

  But, the growth rate of population is, still high in the country.

Demographic Divide

The rate of growth of population was moderate and irregular till 1921. The year of 1921 is known as the "***year of Great***

Divide" or Demographic Divide. The rate of population growth fluctuated between 1.0 and 1.35 per cent per annum.

Population Explosion

The year of 1951 is also termed as **"Population Explosion Year"**. The growth rate of population was 21.5% in the decade of 1951-61.This rate of growth is tremendous was described by economists as ***population explosion***. It gives many problems such as the problem of food shortage, poverty, unemployment, low standard of living.

The population has increased by more than 181 million during the decade 2001-2011. The growth rate in 2011 is 17.64 per cent in comparison to 21.15 per cent in 2001. As per census 2011, Nagaland is the only Indian state which has negative growth rate of -0.58% in census 2011. Dadra and Nagar Haveli is growing at the rate of 55.88% annually while second fastest growth is recoded in Daman & Diu at 53.76% in census 2011.

POPULATION DISTRIBUTION

India's population has jumped to 1.21 billion according to 2011 census. The country's population is almost equal to the combined population of the U.S., Indonesia, Brazil, Pakistan, Bangladesh and Japan put together [1214.3 million].

Population distribution is the spread of people across the country. One of the most important aspects of India's population is its uneven distribution. Reasons that are responsible for uneven population distribution in India -

(i) Variations in topography or relief in different parts of India.

(ii) Variations in climate and rainfall distribution, and

(iii) Variations in the rate of industrialization and urbanization.

On one hand the population of India is highly concentrated in some pockets such as highly urbanized and industrialized areas and areas of high agricultural productivity, while on the other hand there are virtually demographic deserts in high mountains, arid lands, thickly forested areas and some remote corners of the country.

The main factors determining population distribution are –

- ✓ Climate
- ✓ Landforms
- ✓ Topography
- ✓ Soil
- ✓ Energy & mineral resources
- ✓ Distance from sea coast
- ✓ Navigable rivers or canals
- ✓ Cultural factors
- ✓ Political boundaries
- ✓ Controls on migration and
- ✓ Government policies.

Social, demographic and historical factors also affect population distribution. The state wise population distribution as per the recent census 2011 indicates that-

- UP continues to be the most populous state with about 200 million populations (16 per cent of total population).
- States of Maharashtra and Bihar (9 per cent of the total population each) have made the transition to more than 100 million population categories.

- According to the numbers, Sikkim is the least populous state in India.
- Twenty States and Union Territories now have a population of over ten million.
- Five States and Union Territories in the country that are yet to reach the one million mark.
- Half of the country's population is concentrated around five major states- Maharashtra, Uttar Pradesh, West Bengal, Bihar and Andhra Pradesh.
- Though Rajasthan is the largest state in size, its population contributes to only 5.5% of the total population of India.

Factors Influencing the Distribution & Density of Population in India

Major factors influencing the ***distribution and density of population*** are described as under:

1. Terrain

Plain areas encourage higher density of population as compared to mountain regions. The steep slope in mountain areas restrict the availability of land for agriculture, development of transport, industries e.g –The Himalayas –occupies 13% of area but supports 1-2 % of population. But the gentle slope of Indo-Gangetic plain supports opportunities for agriculture, transport and industries.

2. Climate

Extremes of climate discourage the concentration of population. Such climates include the too cold climate of Himalayas, and the too hot and dry climate of the Thar Desert. A moderate climate, on the other hand, is favorable for population.

3. Soils

Fertile soil supports higher population density while infertile soil leads to low density. In the northern plain of India, the soil is regularly enriched by annual floods of the great rivers like the Indus, the Ganga and the Brahmaputra and their tributaries.

4. Water bodies

Rivers are the greatest source of fresh potable water. Therefore, most of the population is concentrated in the river valleys. (Examples) - The Ganga-Brahmaputra deltas, deltas of Peninsular India and the coastal plains.

5. Mineral Resources

The higher population densities in the Chhota Nagpur Plateau of Jharkhand and in the adjoining areas of Orissa are largely due to the availability of minerals.

6. Industries

Industrial growth offers massive employment opportunities and acts as a great magnet to attract people, particularly from the neighboring areas. This results in higher population density. Industrial areas are almost invariably associated with areas of high population densities.

7. Transport

The northern plain of India has a dense network of transport routes and is densely populated region. The peninsular plateau has moderate network of transport route and is moderately populated area. The Himalayan region badly lacks transport facilities and is scarcely populated.

8. Urbanization

Urbanization and population concentration go hand-in-hand and are closely related to each other. All the urban centres are marked by high density of population. The minimum density, that an area should have to be designated as urban, is 400 persons per sq km. The highly urbanized districts of Kolkata, Chennai, Greater Mumbai, Hyderabad, Delhi and Chandigarh have population densities of over 6,000 persons per sq km.

DENSITY OF POPULATION

Population density is a measurement of the number of people in an area. It is an average number. The population density of an area can be one of the most important determining factors for business and marketing planning.

Population density is calculated by dividing the number of people by the area. Population density is usually shown as the number of people per square kilometer.

The formula for calculating population density is

DP= N/A

In this equation, DP is the density of population, N is the total population as a number of people, and A is the land area covered by that population. The records of population density 2011 of India state that the density 2011 has increased from a figure of 324 to that of 382 per square kilometer, which is considerably higher than the average population density of the world 2011, which are 46 per square kilometer.

There are also a lot of differences in the population density of the various states of India. Some areas are densely populated whereas others are sparsely populated. Physical factors that affect population density include water supply, climate, relief (shape of the land), vegetation, soils and availability of natural resources and energy based industries. Following are few examples for uneven density of population-

- The Indo-Gangetic Plains have one of the world's biggest stretches of fertile flat-deep alluvium and are among the most densely populated areas of the world.
- The eastern and western coastal regions of Deccan Plateau are also densely populated regions of India.
- The Thar Desert in Western Rajasthan is one of the least densely populated deserts in the world.
- The northern and north-eastern states along the Himalayas contain cold arid deserts with fertile valleys. These states have relatively less population density due to indomitable physical barriers

Regarding density of population the Census of population 2011 of India show that-

- **Bihar** is the most thickly populated state (1106 persons/sq km.) followed by **West Bengal**-1028 and **Kerala -** 860.
- While the National Capital Region area of **Delhi** possesses the highest of the population density 2011 among the states of India having a statistics of 11,297 per square kilometer, the state of **Arunachal Pradesh** has the lowest record of population density having just 17 per square kilometer.

DENSITY ZONES OF INDIA

The three population density zones of India are as follows:

(i) **High-density zone**: Areas of the Northern Plains, above 500 people per sq.km.

(ii) **Moderate density zone**: regions with 250–500 people per sq.km.

(iii)**Low-density zone**: regions with people below 250 people per sq.km.

(i) High-density zone

Some states like Bihar, West Bengal, Uttar Pradesh and Kerala have a high density of population because most of these states are located in the Northern Plains, which are agriculturally very productive due to fertile alluvial soil, favorable climate, good irrigation, cheap labor and agriculture.

(ii) Moderate density zone

Punjab, Haryana, Tamil Nadu and other states like Karnataka, Andhra Pradesh, Maharashtra, Odisha, Gujarat, Jharkhand and Assam have a moderate density of population. The remaining states

fall in the moderate population density zone with 250-500 persons living per sq km. e.g. Madhya Pradesh, Rajasthan and so on.

(iii)Low-density zone

It is because of the uneven and rugged terrain, Jammu Kashmir, Himachal Pradesh, Uttarakhand, Northeastern states; Rajasthan, Madhya Pradesh and Chhattisgarh have low densities. It is because of hilly, rugged terrain, unfavorable climate, low to moderate rainfall and medium fertile soils, lack of agricultural and industrial development and poor infrastructure. Arunachal Pradesh, the extreme north-eastern state of India, has a population density of only 17 persons per sq. km. Most of the state is hilly and forested. The climate is harsh with low average temperature. Population density lesser than 100 persons per sq km consists of the states Arunachal Pradesh, Mizoram.

PROBLEMS RELATED TO POPULATION IN INDIA

- High population in India is threatening to slow economic development, many environmental and economic problems, such as over-fishing, higher pollution, loss of habitat and stress on water.
- There are more individuals trying to use the same quantity of resources. This can lead to competition for food, water, shelter, mates, light, and other resources needed for survival and reproduction.
- It also leads to poverty, poor standard of living, unemployment.

INDIA- TOTAL POPULATION & POPULATION DENSITY

CENSUS - 2011

State	Population	Area	Population Density
Uttar Pradesh	199,812,341	240,928 km^2	828/km^2
Maharashtra	112,372,972	307,713 km^2	365/km^2
Bihar	103,804,637	94,163 km^2	1,102/km^2
West Bengal	91,347,736	88,752 km^2	1,029/km^2
Madhya Pradesh	72,597,565	308,245 km^2	236/km^2
Tamil Nadu	72,138,958	130,058 km^2	555/km^2
Rajasthan	68,621,012	342,239 km^2	201/km^2
Karnataka	61,130,704	191,791 km^2	319/km^2
Gujarat	60,383,628	196,024 km^2	308/km^2
Andhra Pradesh	49,386,799	162,968 km^2	303/km^2
Odisha	41,947,358	155,707 km^2	269/km^2
Telangana	35,286,757	114,840 km^2	307/km^2
Kerala	33,387,677	38,863 km^2	859/km^2
Jharkhand	32,966,238	79,714 km^2	414/km^2
Assam	31,169,272	78,438 km^2	397/km^2
Punjab	27,704,236	50,362 km^2	550/km^2

Chhattisgarh	25,540,196	135,191 km^2	189/km^2
Haryana	25,353,081	44,212 km^2	573/km^2
Jammu and Kashmir	12,548,926	222,236 km^2	57/km^2
Uttarakhand	10,116,752	53,483 km^2	189/km^2
Himachal Pradesh	6,864,602	55,673 km^2	123/km^2
Tripura	3,671,032	10,486 km^2	350/km^2
Meghalaya	2,964,007	22,429 km^2	132/km^2
Manipur	2,721,756	22,327 km^2	122/km^2
Nagaland	1,980,602	16,579 km^2	119/km^2
Goa	1,457,723	3,702 km^2	394/km^2
Arunachal Pradesh	1,382,611	8,3743 km^2	17/ km^2
Mizoram	1,091,014	21,081 km^2	52/km^2
Sikkim	607,688	7,096 km^2	86/km^2
SOURCE: https://www.indiatoday.in/education-today/gk-current-affairs/story/indian-states-with-highest-population-1358414-2018-10-08			

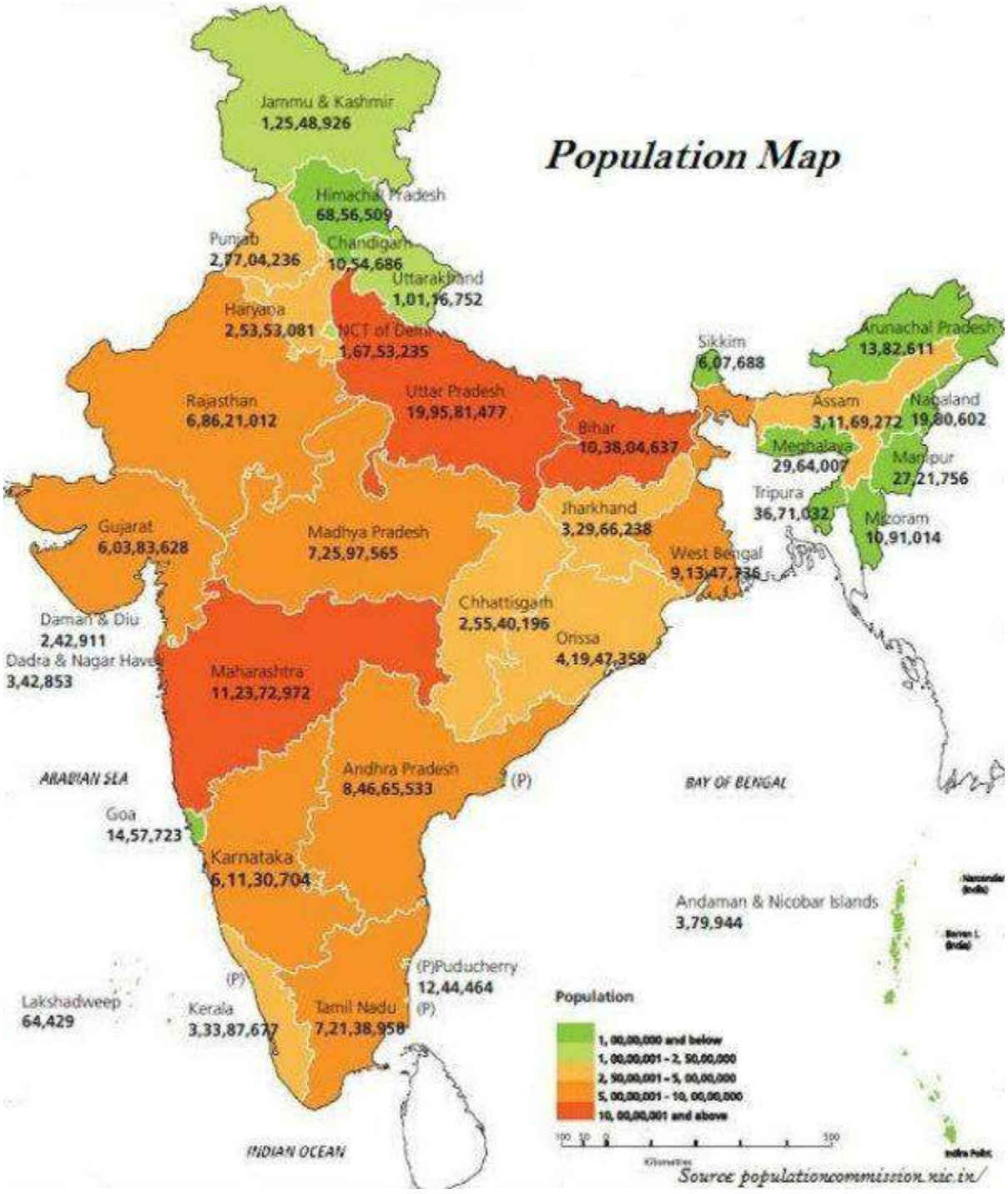
UNION TERRITORIES

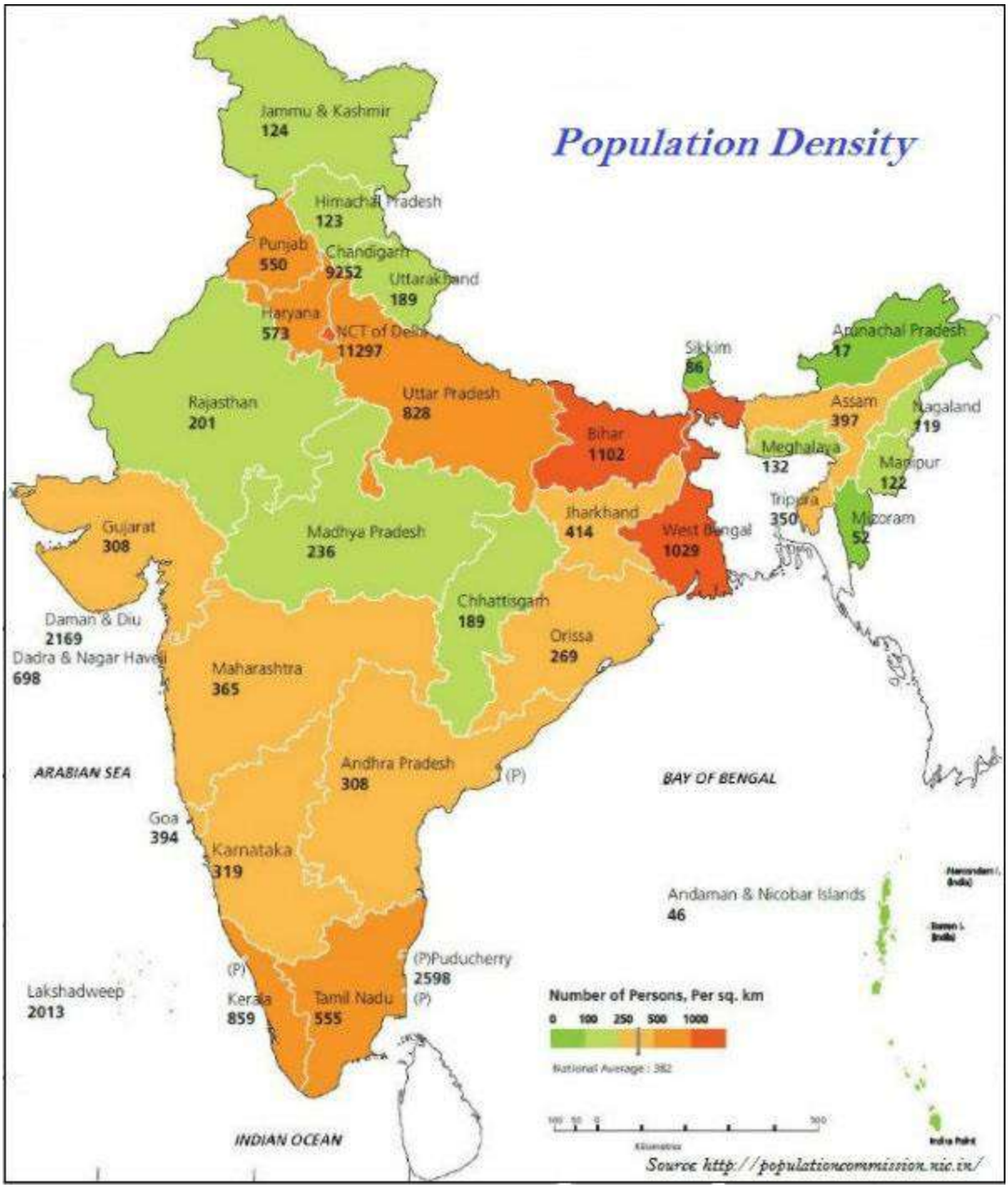
Union Territories	Population	Area	Population Density
NCT of Delhi	1,67,87,941	1484 km^2	11312/km^2
Puducherry	12,47,953	490 km^2	2547/km^2
Chandigarh	10,55,450	114 km^2	9262/km^2
Andaman & Nicobar Island	3,80,581	8250 km^2	46/km^2
Dadra & Nagar Haveli	3,43,709	491 km^2	700/km^2
Daman & Diu	2,43,247	111 km^2	2191/km^2
Lakshadweep	64,473	30 km^2	2149/km^2

SOURCE:

https://www.jagranjosh.com/general-knowledge/census-2011-population-in-states-and-union-territories-of-india-1476439733-1

INDIA- DISTRIBUTION OF POPULATION





SOURCE:https://censusindia.gov.in/2011provresults/data_files/indiaFinal_PPT_2011chapter7.pdf

TRANSPORT

Transport is a system in which passengers and goods move from one place to another. Transportation systems are indispensable to any country's progress. Development of cheap and efficient means of transport is necessary for the progress of a large and developing country like India. India has great diversity in economic, social, cultural and ethnic structure and an efficient transport system is essential to bring about unity in diversity. So, ***"Transportation system is the lifeline of any country."***

The present transport system of the country comprises several modes of transport including rail, road, air transport, shipping, etc. Railways and roads are the dominant means of transport carrying more than 95% of total traffic generated in the country. Public transport is the primary mode of road transport for most of the Indian citizens, and India's public transport systems are among the most heavily used in the world. These days transportation is known as **"the symbol of civilization**".

Highlights of transport

A. Economic Benefits

- Better Production in both Agriculture and Industrial Sectors
- Reduction in Cost of Production
- Reduction in Scarcity
- Growth in Foreign Trade
- Specialization of Labour and Mobilization of Resources
- Promotion of Tourism
- Expands the Market

B. Social Benefits

- More Employment Opportunities
- Education Expansion
- Social and Cultural Spirit
- Higher Standard of Living
- Relationship between Villages and Cities

Means of Transport in India

The various means of transport are:
1. Rail Transport
2. Road Transport
3. Water Transport
4. Air Transport

ROADWAYS OF INDIA

- Roads are the arteries through which the economy pulses.
- Roads reach the door steps.
- Road-system encourages the sale of such perishable goods as vegetable, fruits, milk, butter, etc. in the wide markets.
- It is a most flexible means of transport.
- The road network of India has grown from 4 lakh kms in 1951 to more than 33 lakh km.
- It is the second largest in the world.
- As per a recent survey, India has more than 5,000,000 km of road length and 80 % of road traffic stems from the personal vehicles i.e. Bikes and Cars.
- India has around 1, 250 km of expressways, 71,000 km of national highways, 1, 60,000 km of state highways and around 4, 50,000 km of district or rural area roads approximately.

Different types of Roads in India:

- National highways.
- State highways.
- District highways – (a) Major district roads
  (b) Minor district roads.
- Village roads.

NATIONAL HIGHWAYS OF INDIA

The National highways in India are a network of trunk roads that is owned by the Ministry of Road Transport and Highways. It is constructed and managed by the National Highway Authority of India (NHAI), the National Highways and Infrastructure Development Corporation (NHIDCL), and the public works departments (PWD) of state governments.

The National Highways Authority of India is the nodal agency responsible for building, upgrading, and maintaining most of the National Highways network. NHAI often uses a public–private partnership model for highway development, maintenance, and toll-collection.

National Highways constituted 2.7% of India's total road network, but carried about 40% of road traffic.

List of Important National Highways of India

National Highways	Connectivity
NH -1	Delhi to Amritsar (via Ambala and Jalandhar)
NH-1 A	Jalandhar to Uri (via Madhavpur, Jammu, Srinagar and Baramula)
NH-2	Delhi to Kolkata (via Mathura and Varanasi)
NH-3	Agra to Mumbai (via Gwalior, Indore and Nasik)
NH-4	Thane (Mumbai) to Chennai (via Pune, Belgaum, Hubli, Bangaloru and Ranipet)
NH- 5	Behragoda (Near Kolkata) to Chennai (via Cuttack, Visakhapatanam and Vijaywada)
NH-6	Hazira to Kolkata (via Nagpur, Raipur and Sambalpur, Dhule)
NH-7	Varanasi to Kanyakumari (via Nagpur, Bangalloru and Madhurai)
NH-8	Delhi to Mumbai (Jaipur, Ahmadabad and Vadodara)
NH-9	Pune to Machilipatnam (via Sholapur and Hyderabad, Vijaywada)
NH-10	Delhi to Fazika proceeding to Indo-Pak border
NH-14	Beawar to Radhanpur (Sirohi)
NH-15	Pathankot to Kandla (Near Thar Desert)
NH-24	Delhi to Lucknow
NH-39	Numaligarh to Indo-Myanmar Border

NUMBERING OF NATIONAL HIGHWAYS

- All North-South highways will carry EVEN number
- All East-West highways will have ODD numbers
- All major Highways will be single digit or double digit in number
- North-South highways will increase their numbers from East to West. For example, a particular North-South highway in Central India or Western India will have a higher number than the one in East India.
- Three digit numbered highways are secondary routes or branches of a main highway. For example, 144, 244, 344 etc will be the branches of the main National highway 44.
- Suffixes A, B, C, D etc are added to the three digit sub highways to indicate very small spin-offs or stretches of sub-highways. For example, 966A, 527B etc.

Distribution of National Highways:

A number of national highways run across the country in all directions linking important places to one another. Few examples for National Highways are -

- The historically important Sher Shah Sun Marg is known as National Highway 1. It links Delhi and Amritsar.
- National Highway 2 links Delhi and Kolkata.
- National Highway 3 runs between Agra and Mumbai via Gwalior, Indore and Nasik.
- National Highway 7 is the longest one which links Varanasi with Kanniyakumari via Jabalpur, Nagpur, Hyderabad, Bangalore and Madurai. It traverses a distance of 2,325 km. National Highway 5 and 17 run along the eastern and western coasts respectively.

- National Highway 15 represents the border road in Rajasthan desert and runs through Kandla, Jaisalmer, Bikaner and joins the border road in the Punjab.

The NHDP consists of the following components.

- The Golden quadrilateral (5,846 km) connecting four major cities of Delhi, Mumbai, Chennai and Kolkata.
- The North-South and East-West corridors (7,300 km) connecting Srinagar in the North to Kanniyakumari in the South and Silchar in the East to Porbandar in the West.
- Port connectivity and other Projects (1,133 km).

National Highways Development Programme (NHDP) was launched in 1998 with the objective of developing roads of international standards which facilitate smooth flow of traffic. It envisages creation of roads with enhanced safety features, better riding surface, grade separator and other salient features. National Highways constitute only 2% of the total road length in the country but carry 40% of the total traffic.

NHDP is being implemented by National Highways Authority of India (NHAI), an organization under the aegis of Ministry of Road, Transport and Highways. The programme is being implemented in the following seven phases;

- **Phase I:** Phase I consists of Golden Quadrilateral network comprising a total length of 5,846 km which connects the four major cities of Delhi, Chennai, Mumbai & Kolkata and 981 km of North-South and East-West corridor .NS-EW corridor connects Srinagar in the north to Kanyakumari in the south and Silchar in the east to Porbandar in the west. Phase I also includes improving connectivity to ports.
- **Phase II:** Phase II covers 6,161 km of the NS-EW corridor (The total NS-EW corridor consists of 7,142 km) and 486 km of other NHs.

- **Phase III:** Four-laning of 12,109 km of high density national highways connecting state capitals and places of economic, commercial and tourist importance.
- **Phase IV:** Upgradation of 20,000 km of single-lane roads to two-lane standards with paved shoulders.
- **Phase V:** Six-laning of 6,500 km of four-laned highways.
- **Phase VI:** Construction of 1,000 km of expressways connecting major commercial and industrial townships.
- **Phase VII:** Construction of ring roads, by-passes, underpasses, flyovers, etc. comprising 700 km of road network.

STATE HIGHWAYS

In India, State Highways is the network of roads maintained by the state governments. These roads are constructed and managed by the states' Public Works Department. State governments have the authority and responsibility to build state highways. Most of the state highways are developed by state public works departments. Independently of the NHDP program, state governments have been implementing a number of state highway projects since 2000.

- The state highways are usually roads that link important cities, towns and district headquarters within the state and connect them with National Highways or state highways of neighboring states.
- State highways are highways connecting major cities through-out a state and are also at-grade roads.
- State Highways are designated with SH, followed by the highway number and preceded by state code. Maharashtra has the largest share in the total length of SH roads (22.14%), followed by Karnataka (11.11%), Gujarat (9.76%), Rajasthan (8.62%) and Tamil Nadu (6.67%).

- Construction & Maintenance wing of Highways Department looks after construction, maintenance of all the State Highways (SH), major district roads (MDR), and other district roads (ODR).
- Tamil Nadu State Highways Network has seven circles: Chennai, Villupuram, Madurai, Salem, Tiruchirappalli, Coimbatore and Tirunelveli.

Further, to promote inter-state facilities and also to assist the State Governments in their economic development through construction of roads and bridges, Central Government provides 100 per cent grant for inter-state connectivity and 50 per cent grant for projects of economic importance from CRF(Central Road Fund). Loan assistance from external funding agency is also taken by some states. The distribution of State Highways is very uneven.

Maharashtra has the longest length of state highways; smaller states such as Goa and states in hill areas like Mizoram, Sikkim, Nagaland, Tripura, etc. have less than five hundred km length of State Highways.

INDIAN RAILWAYS

The Indian Railway is one of the oldest and largest railway systems in the world. It has played an integrating role in economic and socio development. Emergence of Metros and Bullet train further glorified the mode of transport. The core cities like Kolkata, Chennai, Bangalore, Gurgaon, Mumbai and Jaipur all been provided the metro connectivity and emerging cities like Pune and Ahmedabad will also benefited in the coming years. Bullet Train is an ambitious project of the government. Since, most of the developed countries in world have high-speed rails, the Indian government is taking all right steps towards becoming a emerging power and thus further igniting the economy.

Significance

- The Indian Railways have been a great integrating force for more than 150 years.
- The Indian Railways network binds the social, cultural and economical fabric of the country and covers the whole of country ranging from north to south and east to west removing the distance barrier for its people.
- The railway network of India has brought together the whole of country hence creating a feeling of unity among the Indians.
- It has helped the economic life of the country and helped in accelerating the development of industry and agriculture.
- Indian railways carry most of long distances passenger traffic and 80% of total freight.
- They also provide mail services.
- They carry big chunks of goods from place of production to ports and vice-versa.

- Iron and steel industries based upon railways as they transport raw materials and finished products from one place to another.

Growth and development

- Introduced in 1853, rail transport services in India are one among the prominent and reliable mode of transport in the country.
- Indian Railways is nothing short of a crucial lifeline to the nation.
- An Indian state owned enterprise, Indian Railways (shortly written as IR), controlled by the Government of India through the Ministry of Railways, run both suburban and long distance services on a network of broad gauge, metre gauge and narrow gauge lines.
- Indian Railways is the third largest network of rail transport in the world after the United States of America and Russian Federation.
- India's rail network is the fourth largest and second busiest in the world, the second largest railway network in Asia.
- IR is the world's eighth-largest employer.
- Indian Railways is separated into various railway zones, which are further sub-divided into various railway divisions.
- At present, the Indian Railways have seventeen railway zones and sixty-eight railway divisions.
- Some of the well known railway zones include southern railway, central railway, western railway, eastern railway, northern railway, south central railway, south western railway and so on.
- Trains in India are broadly classified based on their average speed.
- With the introduction of Train 18 or Vande Bharat Express, transport in Indian railways has seen new heights of success.

- The fastest train at present is the Vande Bharat Express with operation speeds of up to 180 km/h, though the fastest service is Gatimaan Express with an operational speed of 160 km/h (99 mph).
- Rajdhani trains introduced in 1969 provide connectivity between the national capital, Delhi and capitals of the states.
- Shatabdi Express provides connectivity between centres of tourism, pilgrimage or business.
- The IR also operates a number of luxury trains which cater to various tourist circuits. For instance, the Palace on Wheels serves the Rajasthan circuit and The Golden Chariot serves the Karnataka and Goa circuits

Rail Gauges of India

The distance between the two tracks on any railway route is known as railway gauge. There are 4 types of railway gauge used in India - Broad gauge, Metre Gauge, Narrow gauge and Standard gauge (for Delhi Metro).

Broad Gauge

- Broad gauge is also called wide gauge or large line. The distance between the two tracks in these railway gauges is 1676 mm (5 ft 6 in).

Metre Gauge

- The distance between the two tracks is 1,000 mm (3 ft 3 3/8 in). All meter gauge lines except the Nilgiri Mountain Railway which is a legacy run on a meter gauge in India are being converted into broad gauge under project Unigauge.

Narrow Gauge

- The narrow-gauge railway is the railway track, in which distance between two tracks is 2 ft 6 in (762 mm).

- The Darjeeling Mountain Railway has declared UNESCO World Heritage on 24 July, 2008. Kalka Shimla Railway is also very popular.

Standard Gauge

- The distance between the two tracks in this railway gauge is 4 ft 8½ in.

- In India, standard gauge is used only for urban rail transit systems like Metro, Monorail and Tram.

- Till 2010, the only standard gauge line in India was the Kolkata (Calcutta) tram system.

Progress made by Indian Railways

- Steam engines have been replaced by diesel and electrical engines.
- Priority has been assigned to conversion of meter gauge lines into broad gouge.
- Railways tracks are electrified.
- At present, the railways comprise three gauges-broad (1.675m), meter (1.000m) and narrow (0.762m).
- At present 70.72% are broad gauge, 23.92% are meter gauge and 5.36% are narrow gauge.

Measures to reduce the burden of the Railways

- Electrification of railway track.
- Increased used of hydro-electricity.
- Setting up of thermal power plant near coal mines.
- Conversion of railways gauge into broad gauges.
- Replacement of steam locomotives by electrical and diesel engines.
- Greater use of natural gas to produce electricity.

Railway Zones

Far administrative convenience the Railways have been divided into zones. The zones and headquarters are as under:

Zones	Headquarters	Zones	Headquarters
1. Central	Mumbai CST	9. North-eastern	Gorakhpur
2. Eastern	Kolkata	10. North-east Frontier	Mallagaon
3. Northern	New Delhi	11. South Central	Secundrabad
4. Southern	Chennai	12. South-eastern	Kolkata
5. Western	Mumbai Churchgate	13. North central	Allahabad
6. East coast	Bhubneshwar	14. North-Western	Jaipur
7. Bilaspur	Bilaspur	15. South-Western	Banglore
8 .East central	Hazipur	16. West central	Jabalpur

Characteristics of the Distribution of Railway Network

- A dense network of railways has been developed in the Northern plain from Amritsar to Howarh.
- The rail network is highly linked to the level of agricultural development.
- The peninsular region, Gujarat and Tamil Nadu have a dense rail network.
- Trunk routes connect Mumbai with Chennai, Chennai with Kochi, Chennai with Delhi and Chennai with Hyderabad.
- Railways network is sparse in the mountainous terrain of the Himalayas.
- The rugged terrain, backward economy and sparse population are responsible for sparse rail network.No railway is found in Meghalaya, Tripura, Manipur and Nagaland.
- The rail network between East coastal Plains and west coastal plains has a distinct contrast.
- A long trunk route runs all along the East coast but such a rail track is missing along the Western Ghats due to outcrops of Ghats being very close to the coast.

AIR TRANSPORT

Airways provide the fastest mode of transport but they are very costly. For remote hostile and inaccessible areas, airways are the best means of transport. In 1953, air transport was nationalized. Now-a-days four air services are in operation. Aviation Transport is the quickest and the easiest way of transport. However, it underwent a slow growth post- liberalization in India. Privatization led the further progress in industry.

1. Air India
2. Private Air Lines
3. Pawanhans Helicopters
4. Indian Airlines and Alliance air

Factors responsible for progress and popularity

- The air services operate throughout the year as clear and cloudless sky facilities the flying.
- Advanced Aluminium industry facilities the manufacture of aircraft in the country.
- India serves as nodal point on the major air routes between Europe and South-East and East Asia.
- India is a vast country. Hence rail and road transport are time-consuming as they have to cover long distances.

Airports are managed by the Airports Authority of India (AAI). Efforts are on to provide with the latest scientific technology to ensure passengers safety and quick handling of passengers and freight traffic. International airports handle air traffic between the world and India. Airports Authority of India (AAI) manages a total of 125 Airports, which includes 81 Domestic Airports, 11 International Airports, 25 Civil Enclaves at Defence Airfields and 8 Customs Airports.

Airlines of India can be grouped into -

a) Indian Airlines, primarily serving domestic sectors
b) Air India, primarily serving the international sectors

International Airways of India

Air India was founded in 1932. Being India's national airline, it is owned by the Indian government. With its headquarters in New Delhi, this airline connects to major cities of Asia, the Middle East, Europe, Africa, United States of America and Canada. As of December 2019, Air India flies to a total of 102 destinations including 57 domestic destinations and 45 international destinations in 31 countries across five continents around the world. Its primary hub is located at Indira Gandhi International Airport, New Delhi, and it has a secondary hub at Chhatrapati Shivaji Maharaj International Airport, Mumbai.

International airports are –

List Of International Airports in India		
International Airport Name & Code	**International Airport Location**	**Type/Purpose**
Chhatrapati Shivaji International Airport – BOM	Mumbai, Maharashtra	Commercial Airport
Kempegowda International Airport – BLR	Bangalore, Karnataka	Commercial Airport
Chennai International Airport – MAA	Chennai, Tamil Nadu	Commercial Airport
Netaji Subhas Chandra Bose International Airport – CCU	Kolkata, West Bengal	Commercial Airport

Chaudhary Charan Singh International Airport – LKO	Lucknow, Uttar Pradesh	Commercial Airport
Sri Guru Ram Dass Jee International Airport – ATQ	Amritsar, Punjab	Commercial Airport
Visakhapatnam International Airport – VTZ	Visakhapatnam, Andhra Pradesh	Civil Enclave
Kannur International Airport – CNN	Kannur, Kerala	Commercial Airport
Surat International Airport – STV	Surat, Gujarat	Commercial Airport
Devi Ahilya Bai Holkar Airport – IDR	Indore, Madhya Pradesh	Commercial Airport
Cochin International Airport – COK	Kochi, Kerala	Commercial Airport
Sardar Vallabhbhai Patel International Airport – AMD	Ahmedabad, Gujarat	Commercial Airport
Indira Gandhi International Airport – DEL	Delhi	Commercial Airport
Dabolim Airport – GOI	Goa	Civil Enclave
Pune Airport – PNQ	Pune, Maharashtra	Civil Enclave
Thiruvananthapuram International Airport – TRV	Thiruvananthapuram, Kerala	Commercial Airport
Coimbatore International Airport – CJB	Coimbatore, Tamil Nadu	Commercial Airport
Calicut International Airport – CCJ	Calicut, Kerala	Commercial Airport
Biju Patnaik International Airport – BBI	Bhubaneswar, Odisha	Commercial Airport
Lokpriya Gopinath Bordoloi International Airport – GAU	Guwahati, Assam	Civil Enclave

Lal Bahadur Shastri International Airport – VNS	Varanasi, Uttar Pradesh	Commercial Airport
Rajiv Gandhi International Airport- HYD	Hyderabad, Telangana	Commercial Airport
Tiruchirappalli International Airport – TRZ	Tiruchirappalli, Tamil Nadu	Commercial Airport
Dr. Babasaheb Ambedkar International Airport – NAG	Nagpur, Maharashtra	Commercial Airport
Sheikhul Aalam International Airport – SXR	Srinagar, Jammu and Kashmir	Civil Enclave
Imphal International Airport – IMF	Imphal, Meghalaya	Commercial Airport
Jaipur International Airport – JAI	Jaipur, Rajasthan	Commercial Airport
Madurai Airport – IXM	Madurai, Tamil Nadu	Customs, Commercial
Bagdogra International Airport – IXB	Siliguri, West Bengal	Commercial Airport
Jay Prakash Narayan International Airport – PAT	Patna, Bihar	Commercial (Restricted International Flights, Customs)
Mangalore International Airport – IXE	Mangalore, Karnataka	Commercial Airport
Chandigarh International Airport – IXC	Chandigarh	Civil Enclave (Restricted International Flights, Customs)

Source: https://byjus.com

International Airports in India – Important Pointers

- There are 34 operational International Airports in India.
- Indira Gandhi International Airport is the largest International airport constructed in 5495 acres. It is also the busiest airport in India followed by the Chhatrapati Shivaji International Airport.
- Cochin International Airport, Kerala is the first international airport in India developed under PPP- Public-Private Partnership Model.
- Calicut International Airport, Kerala is recently added to the list of International Airports in India.
- Juhu Aerodrome, Mumbai is the First and oldest Airport in India founded in 1928
- Airport of Trichy is the smallest airport in India.
- Kushok Bakula Rimpochee, Ladhak is the 23rd highest commercial airport in the world at 3256 meters.

Domestic Airways of India

Domestic flights are flights within a specific country's boundaries. Airports within the country or domestic airports operate international flights, i.e., flights to foreign countries, frequently. Furthermore, some domestic airports lack customs and immigration facilities, which is why they do not operate flights to or from other countries. These airports have small runways and sometimes a single runway, and possess limited facilities. Domestic flights can be arranged for military purposes.

For domestic flights, passengers use domestic terminals. There are currently 39 airlines operating in India including scheduled, regional, chartered and cargo airlines. The

scheduled airlines are the primary carriers who command a majority of the domestic market share.

Best domestic airlines in India are

- Air India
- Vistara
- Indigo
- SpiceJet
- GoAir and more.

Domestic Airport Facilities and Services

- Domestic airports offer a wide range of facilities and services for the benefit and comfort of travelers.
- There are VIP lounges and other areas in airports where passengers can sit back and relax with a cup of coffee or tea as you watch TV or browse the Internet using the free Wi-Fi facility.
- Some airports have spa facilities and shower and massage lounges for the passengers to rejuvenate after long and tiring flights.
- Shopping outlets, food stalls, and restaurants among other things make the airports a destination within themselves.
- Facilities for the ease of the passengers include escalators, elevators, baggage trolleys, tourist information counters, money exchange counters, ATMs, and banks.
- Additionally, there are baby-care rooms, wheelchairs and assistance to the physically disabled, smoking rooms, and shower rooms in some well-equipped domestic airports.

Key Services at the Domestic Airports

- Commercial facilities at airports include duty-free shops, book stalls, and restaurants.
- Many cargo airlines operate from the domestic airports to different destinations.
- There are civil enclaves allotted to armed forces and are used for military flight training.

- The airports at Delhi, Mumbai, Hyderabad, etc. provide VIP and royal concierge services.
- Major Infrastructure of the Airports

Some Popular Domestic Airports

- Indira Gandhi International Airport (DEL) in New Delhi
- Chhatripati Shivaji International Airport (BOM) in Mumbai, Maharashtra
- Rajiv Gandhi International Airport (HYD) in Hyderabad, Telangana
- Chennai International Airport (MAA) in Chennai, Tamil Nadu
- Kempegowda International Airport (BLR) in Bangalore, Karnataka
- Cochin International Airport (COK) in Cochin, Kerala

The role of Transport Network in the Development of India

- **Life Lines of the country**: - Modern means of transport provide a helping hand in maintaining the sovereignty and economic unity of a nation.
- **Turning of local market into national market:** Transport network turns local markets of previous day into national market of today.
- **Help in development of economy:** Development of the transport network increases the mobility of people.
- **National integration of the country: -** Air transport brings immediate and distant neighbors closer to each-other in the present world of Trade and Commerce.
- **Unity in diversity: -** Transport Network begins people of different castes, creeds, colors, religions, languages and regions nearer to one another.
- **Integrity:** They act, react and interact with one another. Thus transport network helps in the cultural and national integration of the country

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TRADE

Trade is a basic economic concept involving the buying and selling of goods and services or the exchange of goods or services. Trade agreements may boost exports and economic growth, but the competition they bring is often damaging to small, domestic industries. Trade can be divided into following two types –

Internal or Home or Domestic trade –

- Domestic trade happens when this business is conducted inside of a country's borders.
- Domestic trade or internal trade is the trade which takes places between the different regions of the same country (e.g., the trade between Calcutta and Mumbai or Calcutta and Chennai, etc.).
- Payment for goods and services is made in the currency of the **home** country.
- It involves transactions between the producers, consumers and the middlemen.
- It consists of a distribution network engaged in exchange of goods and services.

External or Foreign or International trade –

- The exchange of goods and services between countries and across borders is referred to as international trade.
- Foreign trade leads to specialization and encourages production of different goods in different countries.
- International trade refers to trade between two different countries (such as India and Bangladesh) or one country and the rest of the world (e.g., India and Great Britain, Germany, U.S.A., etc.).
- The former is called bilateral trade and the latter multilateral trade.

Composition of India's Foreign Trade

Composition of foreign Indian foreign trade means major commodity or sectors in which India is doing export and import. **Imports** and **exports are** the components of international trade. Since independence, composition of export trade of India has undergone a change.

IMPORTS OF INDIA

Imports are the goods and services bought by a country's residents that are produced in a foreign country. India imports around 6000 commodities from 140 countries.

After independence, as a result of industrialization, there has been a change in India's import trade from primary products to capital goods. Previously, India's major imports consisted of food grains, cotton, jute, etc. But, after that the trend has changed.

Now the import of primary fertilizers, iron and steel, non-ferrous metals, and other industrial inputs has increased. The changes in the composition of imports have resulted to meet the consumption and investment needs of the growing economy.

India's main imports are:

- Mineral fuels, oils and waxes and bituminous substances (27 percent of total imports);
- Pearls, precious and semi-precious stones and jewelry (14 percent);
- Electrical machinery and equipment (10 percent);
- Nuclear reactors, boilers, machinery and mechanical appliances (8 percent);
- Organic chemicals (4 percent).

India's major import partners are:

- China (16 percent of total imports),
- The United States (6 percent), United Arab Emirates (6 percent),
- Saudi Arabia (5 percent) and
- Switzerland (5 percent)

EXPORTS OF INDIA

Exports are the goods and services produced in one country and purchased by residents of another country. An export in international trade is a good or service produced in one country that is sold into another country. India exports approximately 7500 commodities to about 190 countries.

Before independence, India used to export-

- Agricultural products and raw materials, like jute, cotton, tea, oil seeds, leather, food grains, cashew nuts
- Mineral products. It also exported
- Manufactured goods.

But now in its export mostly manufactured items like-

- Machines
- Ready-made garments
- Gems and Jewellery
- Agricultural products like tea, jute manufactures, Cashew Kernels,
- Electronic goods
- Hardware's and software's which occupy prime place in exports.

As a result of industrial progress during the planning period, there has been an increasing diversification of Indian exports over the years. As the economy progressed, a large number of finished goods, like capital goods and other engineering items, chemical and chemical products, leather and leather manufactures, readymade garments,

handicrafts, etc. have entered the export list and their share has increased considerably. Since the beginning of 1980's crude petroleum has emerged as a significant item in Indian exports.

The transformation in the composition of India's exports has been made possible because of rapid growth and diversification of Indian industries.

Direction of India's foreign Trade

Before independence, the direction of India's foreign trade was with England and its colonies. After independence, as India's political and economic relations with other countries developed, its trade also expanded to too many new directions.

The direction of both imports and exports of India has changed significantly. At present, India's major trading partners are: U.S.A., U.K., U.S.S.R., Japan, Germany, France, Iran, Belgium and Saudi Arabia.

BALANCE OF TRADE

Balance of trade (BOT) is the difference between the value of a country's imports and exports for a given period. The way to calculate this balance of trade is to take the total value of all imports and subtract the total value of all exports.

Balance of Trade formula = Country's Exports – Country's Imports

If the exports of a country exceed its imports, the country is said to have a ***favorable balance of trade, or a trade surplus***.

If the value of a country's imports exceeds the value of its exports, the country has a negative or ***unfavorable balance of trade (BOT),*** also known as a ***trade deficit.***

A country's balance of trade is defined by its net exports (exports minus imports) and is influenced by the following factors that -

- ✓ Productivity
- ✓ Trade policy
- ✓ Exchange rates
- ✓ Foreign currency reserves
- ✓ Inflation and
- ✓ Demand

The balance of payments on current account of India has been in deficit for most of the years. Deficit on current account implies that the residents of a country are spending more on imports of goods and services than the incomes they are earning from exports. So, we can conclude India experiences unfavorable balance of trade.

LIBERALISATION

The terms *Liberalization, Globalization and Privatization* were the three components of New Economic Policy of India in 1991.

Liberalization- means freedom of producing units from the direct control of the government.

Globalization- implies the removal of barriers to international trade and investment.

Privatization- involves the private sector in the ownership of a state owned enterprise.

The economic liberalization in India refers to

- The economic liberalization of the country's economic policies
- Making the economy more market and service-oriented and
- Expanding the role of private and foreign investment.
  The government of India has introduced liberal reduction in taxation rates on direct tax & indirect tax, customs, excise and service. The aim was to permit Indian and foreign manufacturers to enter into power, road, communication and petroleum sector. It removed the restrictions on foreign investments and the control over imports and exports.

The main objectives of the liberalization policy are as follows:

- To increase foreign investment and technology.
- To increase the competitive position of Indian goods in the international markets.
- To improve finance and facilitate modernization.

PROCESS OF LIBERALIZATION

1. Exemption of industries from licensing.
2. Expansion of industries.
3. Freedom of production.
4. Free import of machinery and raw material from abroad.
5. Extending investment limit of small industries.

There were several effects of liberalization on the Indian economy. Some of the advantages are as follows –

- It has opened up the Indian economy to foreign investors.
- India's private sector can engage in core industries, which were previously limited to the public sector.
- Growth of GDP (Gross Domestic Product)
- Development of Infrastructure (roads, electricity etc.,)
- Export and import have become simpler
- Increased employment opportunities.
- Technological up gradation
- Control of price
- Rise in exports.

Disadvantages of Liberalization

- Increase in unemployment.
- Loss to domestic unit.
- Increased dependence on foreign nation.
- Increased regional disparities among states.
- Damage to cottage and small scale industries.
- Inflation

GLOBALIZATION

Globalization is the word used to describe the growing interdependence of the world's economies, cultures, and populations. It is brought about by cross-border trade in goods and services, technology, and international flow of investment. Globalization is a process of interaction and integration among the people, companies, and governments of different nations, aided by information technology. It becomes easy to sell goods and services after the introduction of Globalization.

Process of Globalization in India

- Raising foreign equity participation
- Long period of trade policy
- Encouragement to open competition
- Modernization of the economy
- Privatization of the economy

The following are the positive impacts of globalization on the Indian economy:

Advantages-

- Increased foreign investment in India.
- Greater cultural exchange and helped the tourism sector in India.
- Opening up of the Indian markets to foreign goods.
- The greater competition among companies leading to improvement of quality with reduction in prices of the products.
- Newer technology and improved ways of production leading to efficiency in the local industries.
- It enabled many Indian companies to emerge as MNC's like Tata Motors, Infosys etc.

Disadvantages

- Globalization has increased the gap between the rich and the poor. Globalization makes the rich richer and the poor poorer.
- It worsened the situation of farmers due to import of cheap agricultural goods.
- Decrease of jobs in manufacturing sector.
- It destroys the indigenous industrial sector
- The increase in traffic between countries has polluted the tourist destinations.
- The poisonous gases released into the air by large industries have caused environmental pollution.
- Many communities failed to preserve their old tradition, custom, and culture.

With the introduction of Liberalization and Globalization, the global market treats the world as a single market. With the introduction of Information Technology, the world is focused as a global village and all traders are globalized.

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