

# VISION IAS

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## GENERAL STUDIES MAINS

STUDY MATERIAL

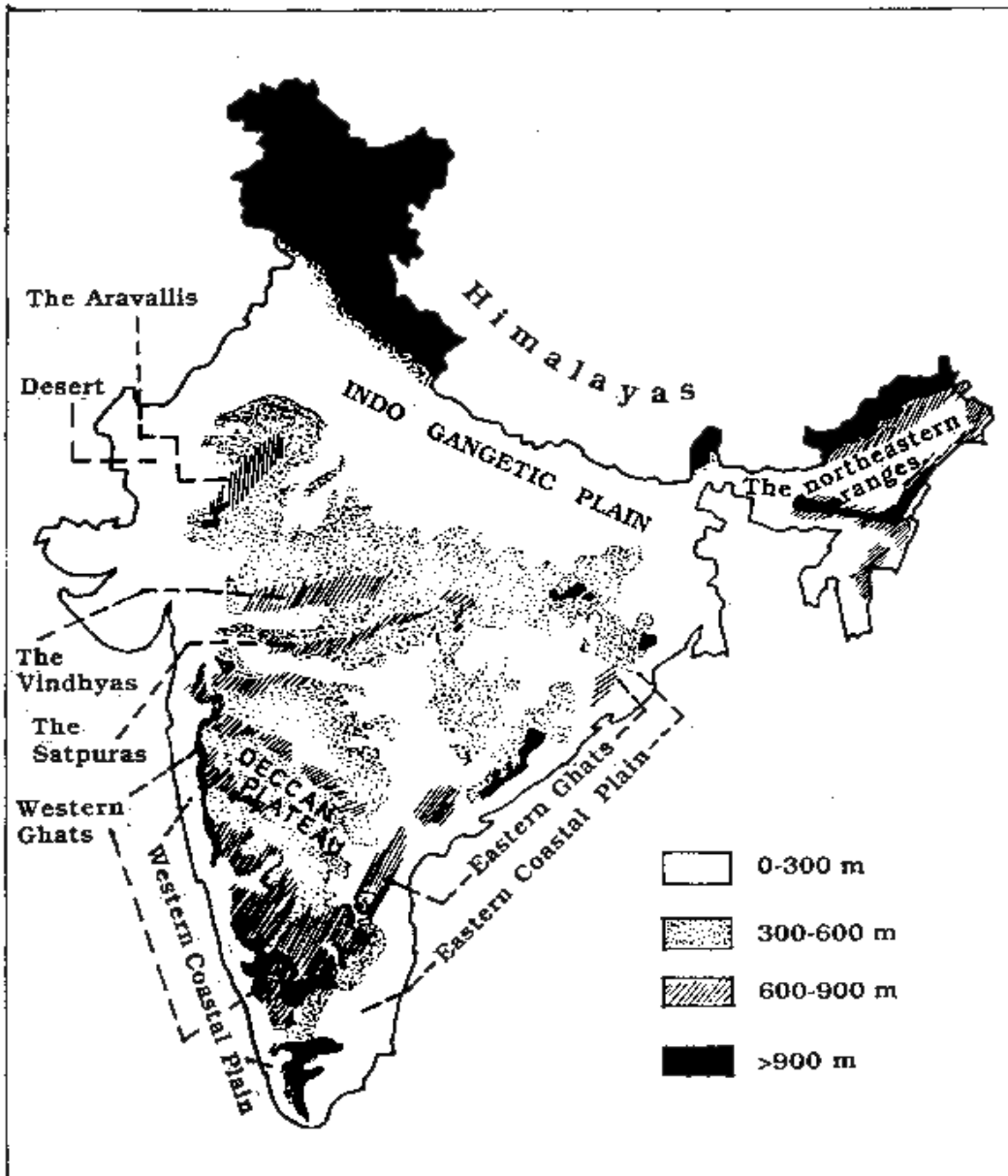
### GEOGRAPHY OF INDIA

#### PART I

## India- Physiography

India can be divided into four physical divisions. They are:

- 1) The Northern Mountains
- 2) The North Indian Plain
- 3) The Peninsular Plateau
- 4) The Coastal regions and Islands



**1. THE NORTHERN MOUNTAINS:** The Himalayan mountains form the northern mountain region of India. They are the highest mountain ranges in the world. They have the highest peaks, deep valleys, glaciers etc. These mountain ranges start from Pamir Knot in the west and extend up to Purvanchal in the east. They extend over 2,500 km. They have been formed during different stages of continental drift of the Gondwanaland mass. There are three parallel ranges in the Himalayas. They are (a) The Greater Himalayas or Himadri, (b) The Lesser Himalayas or Himachal and (c) The Outer Himalayas or Siwaliks.

**2. NORTH INDIAN PLAIN:** The North Indian plain is also called the Gangetic plain. The total area of this plain is about 6,52,000 sq. km. This plain is situated between the Himalayan Mountains in the north and the Peninsular plateau in the south and is formed by the alluvium brought down by the rivers. The plain is very fertile and agriculture is the main occupation of the people. Many perennial rivers flow across the plain. Since the land is almost flat, it is very easy to construct irrigation canals and have inland navigation. It has excellent roads and railways, which are helpful for the establishment of many industries. 40% of the total population of India lives here and it is called "The heart of India".

**3. PENINSULAR PLATEAU:** It is the largest of India's physical divisions. It is the oldest and is formed of hard rocks. The Narmada rift valley divides the peninsular plateau into two parts. They are the Malwa plateau and the Deccan plateau. The Malwa plateau is bounded by the Aravalli hills in the north-west and the Vindhya Mountains in the south. The total area of both these plateaus is 7,05,000 sq. km. and the shape is triangular. The Malwa plateau slopes towards the Gangetic Plain. The highest peak on the Aravallis is Mt. Guru Shikhar. The Deccan plateau is surrounded by the Satpura hills, the Mahadeo hills, the Maikala range, the Amarkantak hills and the Rajmahal hills in the north and the Western Ghats in the west and the Eastern Ghats in the east. The Western Ghats are called Sahyadris in Maharashtra and Karnataka and further south they are called Nilgiris in Kerala and Annamalai range, Cardamom and Palani hills in Tamilnadu. Anaimudi in Annamalai range (2,695 mts.) is the highest peak in South India. The Western Ghats and the Eastern Ghats meet in the Nilgiri hills. The Peninsular plateau has economic importance because of its rich mineral resources and many rivers, which have waterfalls. They help in the generation of hydroelectric power. The plateau is also suitable for the cultivation of cotton and the dense forests are the home of many wild animals.

**4. COASTAL PLAINS AND ISLANDS:** Excluding the islands, the mainland of India has 6,100 kms length of coastline. It extends from Kachchh in Gujarat in the west to the Gangetic delta in the east. The coast of India is divided into western coast and eastern coastal plains. The western coastal plain lies between the Western Ghats and the Arabian Sea and from the Gulf of Kachchh in the north upto Cape Comorin (Kanyakumari) in the south, with a length of about 1,500 km. It is divided into Malabar coast, Karnataka coast(Canara), Konkan coast, Gujarat coast and Kachchh and Kathiawad peninsulas. The coast is straight and affected by the South-West Monsoon winds over a period of six months. So, there are only a few good harbours Mumbai, Marmagoa, Cochin, Mangalore, Karwar, Nhava-Sheva and Kandla are the important ports on the West Coast. The eastern coast extends from Kanyakumari to the Gangetic delta and between the Eastern Ghats and the Bay of Bengal. It consists of the deltas of rivers Mahanadi, Godavari, Krishna and Kaveri. It is a broad and flat land. There are some salt water lakes or lagoons. Chilka Lake of Orissa and

Pulicat Lake of Tamilnadu are the best examples. The Eastern Coast is divided into Coromandel coast in the south and Utkal coast in the north. The coastal regions of India are noted for agriculture, trade, industrial centres, tourist centres, fishing and salt making. They provide important hinterlands for the ports. These coastal plains play a very important role in the economic development of India.

**ISLANDS OF INDIA:** There are 247 islands in India, out of which there are 204 islands in the Bay of Bengal and 43 islands in the Arabian Sea. There are a few coral islands in the Gulf of Mannar also. The Andaman and Nicobar Islands in the Bay of Bengal consist of hard volcanic rocks. The middle Andaman and Great Nicobar Islands are the largest islands of India. Lakshadweep islands in the Arabian Sea are formed by corals. The southern - most point of India is in the Greater Nicobar Island. It is called Indira Point (formerly it was called Pigmalion Point),now submerged after 2004 Tsunami.

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### **SIGNIFICANCE OF HIMALAYAS-**

- 1) Strategic significance. A natural frontier of India with other countries(China, Pakistan, Afghanistan,etc)
- 2) Climatic significance. Prevent further northward movement of summer monsoon and also prevent cold northern winds from Siberia to enter into India.
- 3) Agricultural significance. Formation of Himalayas created a trough to its south which is later filled by the sediments from the Himalayan rivers which is today known as northern plains-Indo-gangetic plains- Rich agricultural grounds.
- 4) Economic significance- Himalayan rivers have huge hydro-electric power potential. Moreover, Himalyan timber and medicinal plants have economic significance.
- 5) Tourist spot- large ecological diversity and hill stations

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### **SIGNIFICANCE OF INDIAN OCEAN FOR INDIA-**

- 1) Strategic significance- India overlooks some of the most important sea lanes viz suez canal, Malacca strait.
- 2) Economic significance- Long coastline, 2.02 million sq km EEZ ( exclusive economic zone)- Hydrocarbons, fishery potential, wave energy, tidal energy, OTEC.
- 3) Marine biodiversity and rich ecosystem with coral reefs, mangroves- Tourist attraction.
- 4) SW monsoon generates in Indian ocean.

## **DIFFERENCE BETWEEN WESTERN GHATS AND EASTERN GHATS-**

### **WESTERN GHATS**

- More continuous
- Higher in elevation
- Sahayadris, anamalai, nilgiri and cardamom hills
- Form excellent escarpments
- Rich watersheds give birth to large peninsular rivers like Godavari and Krishna.
- Separated from coast by narrow coastal plains.

### **EASTERN GHATS**

- Discontinuous
- Lower in elevation
- Do not develop steep escarpments, lack well developed peaks.
- Do not give birth to important rivers like western ghats.
- Separated from coast by very wide coastal plains.
- Geologically older than western ghats.

## **DIFFERENCE BETWEEN BOB ISLANDS AND ARABIAN SEA ISLANDS-**

ANDAMAN & NICOBAR ISLANDS- These are volcanic islands representing submarine volcanism. These islands represent the surfaces of submerged folds. (extension of Himalayas- and precisely Arakan yoma fold mountains of Myanmar). These islands are formed of granitic rocks. Have hills and tall peaks like saddle peak. Climate is equatorial. And comprise of tropical rain-forests.

LAKSHADWEEP ISLANDS- These are a union of coral islands, entirely different from A & N islands, comprising of large number of dead corals, fringing, barrier coral reefs and atolls. Thus these islands have calcium rich soils- organic limestones. Have scattered vegetation of palm species.

## **DECCAN TRAP AND ITS CHARACTERISTICS-**

It is the deccan plateau region which includes Kathiawar plateau of Gujarat and most of Maharashtra, south west MP and NW Karnataka.

It is a volcanic plateau made up of horizontal layers of solidified lava forming trap structure which have a step like appearance. In between the layers of solidified lava, sedimentary layers are also found thus making it inter-trappean

in structure. The deccan plateau slopes towards east and south and descends abruptly towards west making sahayadri ranges.

#### **COASTAL ECOSYSTEM & ITS POLLUTION IN INDIA-**

The coastal domain is from 200 m above to 200m below sea level. Coastal ecosystem presents a delicate equilibrium among different components, viz. estuaries, coral reefs, salt marshes, mangrove swamps, macrophyte dominated regions, continental shelves, etc. at a given time.

Most pollution in India arises from land-based sources - industrial & domestic wastes and agricultural run-off. Shipping and associated ship-building, breaking and port activities are becoming increasingly significant. The crop of recently started coastally located industries use sea-water as a resource and the coastal domain as a sink of altered sea-water [temperature and density]. These pose newer, more direct threats to sensitive eco areas.

A compilation of the type and quantum of pollutants into the coastal ecosystem of India are given below:

<b>Sr. No.</b>	<b>Input / pollutant</b>	<b>Quantum - Annual</b>
1.	Sediments	1600 million tonnes
2.	Industrial effluents	$50 \times 10^6 \text{ m}^3$
3.	Sewage - largely untreated	$0.41 \times 10^9 \text{ m}^3$
4.	Garbage and other solids	$34 \times 10^6$ tonnes
5.	Fertilizer – residue	$5 \times 10^6$
6.	Synthetic detergents - residue	1,30,000 tonnes
7.	Pesticides – residue	65, 000 tonnes
8.	Petroleum hydrocarbons (Tar balls residue)	3,500 tonnes
9.	Mining rejects, dredged spoils & sand extractions	$0.2 \times 10^6$ tonnes

Indian coasts have a large variety of sensitive eco-systems. Sand dunes, coral reefs, mangroves, seagrass beds 7 wet lands are some that deserve special mention. Some of these are the spawning grounds and nurseries of a number of commercially important fishes, gastropods and crustaceans. A critical feature of these ecosystems are the variety of bioactive molecules that they host.

Thus, sustainable development of the coastal ecosystem is must. Sustainable development can be described as "the proper use and care of the coastal environment borrowed from future generations".

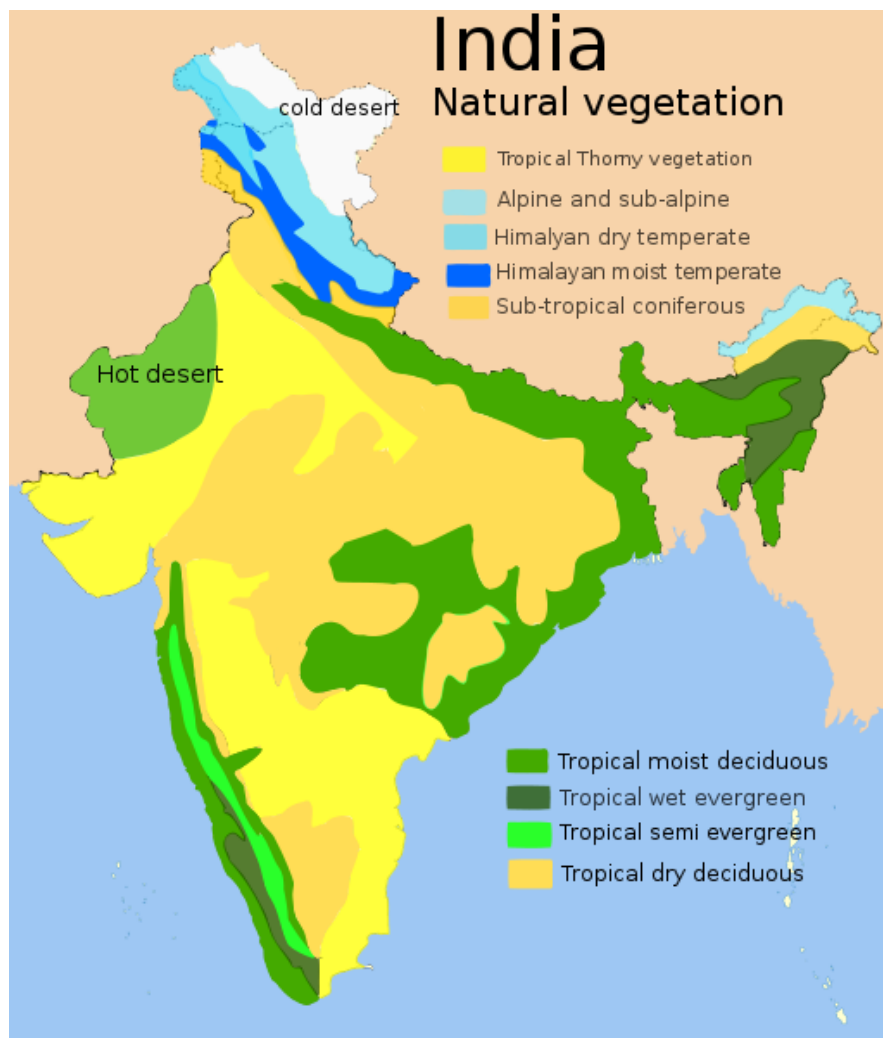
## SHORT NOTES ON-

**Bhabhar-** a zone of porous and rocky soils made up of debris washed down from the higher ranges. The rivers usually disappear in this belt. The Bhabhar and the lower Shiwalik ranges have a subtropical climate. This belt is just above terai.

**Terai-** Above the alluvial plain lies the Terai strip, a seasonally marshy zone of sand and clay soils. The Terai has higher rainfall than the plains, and the downward-rushing rivers of the Himalaya slow down and spread out in the flatter Terai zone, depositing fertile silt during the monsoon season and receding in the dry season. The Terai has a high water table due to groundwater percolating down from the adjacent zone.

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## Natural Vegetation of India



**The following are the principal types of natural vegetation in India:** (1) Tropical Evergreen Rain Forests, (2) Deciduous or Monsoon Type of Forests, (3) Dry Deciduous Forests and Scrubs, (4) Semi- Desert and Desert Vegetations, (5) Tidal or Mangrove Forests and (6) Mountain Forests.

**Tropical evergreen rain forests:** These forests grow in areas where rainfall is more than 200 cm. They are mainly found on the slopes of the Western Ghats and the Northeastern regions of Arunachal Pradesh, Meghalaya, Assam, Nagaland, the Tarai areas of the Himalayas and the Andaman groups of Islands. The trees in these belts have dense growth. Important varieties of trees are sishu, chap lash, rosewood, mahogany, bamboos, garjan and sandalwood.

**Deciduous or Monsoon type of forests:** These forests are found in areas where the rainfall is between 100 cm and 200 cm. These forests grow on the lower slope of the Himalayas, Assam, West Bengal, Bihar, Jharkhand, Orissa, Madhya Pradesh, Chhattisgarh, Maharashtra, Karnataka and the adjoining regions. The trees of these forests shed their leaves during dry winter and dry summer. The main trees are teak, sal, sandalwood, deodar, blue gum, ebony, sis am, jackfruit, mahua, pal ash, arjun, khair and bamboo.



**Dry deciduous forests and Scrubs:** These forests grow in areas where the rainfall is between 50 cm and 100 cm. These are found in areas of central Deccan plateau, South-east of Rajasthan, Punjab, Haryana and parts of Uttar Pradesh and Madhya Pradesh. Dwarf Deciduous trees and long- grasses grow in these regions. Most of the areas are used for agriculture.

**Semi- deserts and Deserts vegetations:** These types of vegetation grow in areas where rainfall is less than 50 cm. Mostly thorny bushes, acacia, babul and sand binding grasses are found in this vegetation zone. The Indian wild date is common in these deserts. These plants grow far apart from each other. They have long roots and thick fleshy stems in which they store water to survive during the long drought. These vegetations are found in Rajasthan and parts of Gujarat's, Punjab and Karnataka.

**Tidal or Mangrove forests:** These forests grow along the coast and on the edges of the deltas e.g., the deltas of the Ganga, Mahanadi, Godavari, Krishna and Kaveri. They are called 'Tidal Forests'. In West Bengal these forests are known as 'Sundarbans'. The 'sundari' is most significant tree in these forests. The other notable trees of these forests are hogla, garan, gewa, golpata, gilepata, pasur etc. These forests supply timber and fire wood. Palm and coconut trees adorn the coastal strip.

**Mountain forests:** Mountain forests vary considerably along the slopes of mountain. On the foothills of the Himalayas upto a height of 1500 meters, evergreen trees, (Sal, teak, bamboo and cane) grow abundantly. On higher slope between 1,500 meters to 3,500 meters, temperate conifer trees, (pine, fir, oak, maple, deodar, laurel spruce, cedar) grow. At the higher altitude of the Himalayas, rhododendrons and junipers are found. Beyond these vegetation belts, alpine grasslands appear up to snowfield.

#### **MANGROVE FORESTS-**

Uses-

- Obstruct oncoming high waves and tides thus protect coastal erosion
- Absorb pollutants
- Reduce coastal erosion
- Absorb storm energy
- Rich breeding grounds for fish

#### **WASTELAND AND WASTELAND DEVELOPMENT-**

Wasteland is barren & highly degraded land not fit for agriculture.

Dept of Land resources, GOI , divides wasteland into 16 categories:

- |  |  |   |
|--|--|---|
| 1. Gullied and/or Ravinous Land                        | 2. Upland with or without Scrub        | 3. Waterlogged and Marshy Land                  |
| 4. Land Affected by Salinity/Alkalinity Coastal/Inland | 5. Shifting Cultivation Area           | 6. Under utilised/Degraded notified Forest Land |
| 7. Degraded Pastures/Grazing Land                      | 8. Degraded Land under Plantation crop | 9. Sands-Inland/Coastal                         |

10. Mining/Industrial Wastelands      11. Barren Rocky/Stony Waste/Sheet Rock Area      12. Steep Sloping Area
13. Snow Covered and/or Glacial Area      14. Total Wastelands      15. Total Geographical Area
16. Percentage of total Geographical Area.

### **INTEGRATED WASTELAND DEVELOPMENT PROGRAMME (IWDP)-**

#### **Objectives:**

The basic objective of this scheme is an integrated wastelands development based on village/micro watershed plans. These plans are prepared after taking into consideration the land capability, site condition and local needs of the people.

The scheme also aims at rural employment besides enhancing the contents of people's participation in the wastelands development programmes at all stages, which is ensured by providing modalities for equitable and sustainable sharing of benefits and usufructs arising from such projects.

#### **Activities:**

The major activities taken up under the scheme are:

- In situ soil and moisture conservation measures like terracing, bunding, trenching, vegetative barriers and drainage line treatment.
- Planting and sowing of multi-purpose trees, shrubs, grasses, legumes and pasture land development.
- Encouraging natural regeneration.
- Promotion of agro-forestry & horticulture.
- Wood substitution and fuel wood conservation measures.
- Awareness raising, training & extension.
- Encouraging people's participation through community organization and capacity building.
- Drainage Line treatment by vegetative and engineering structures
- Development of small water Harvesting Structures.
- Afforestation of degraded forest and non forest wasteland.
- Development and conservation of common Property Resources.

## **Approach**

Wasteland Development through holistic development of Degraded watershed.

Employment of people through Institutional arrangements

Planning from below bottom up approach.

Sustainability through people's participation.

Equitable distribution of Usufructs.

## **The problem**

The degradation of environment in the fragile Indian sub-tropical eco-system is basically attributed to:-

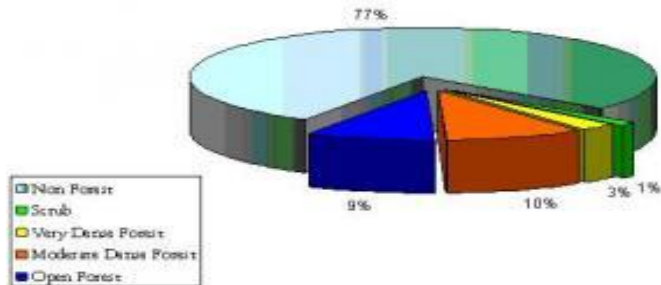
- Increasing biotic pressure
- Absence of adequate investments and appropriate management practices.
- High rate of Population growth and high incidence poverty in rural areas.
- Over-exploitation of National Resources.
- The break-down of traditional institutions for managing common property resources and failure of new institutions to fill the vacuum.
- Faulty land use practices.

## **CONSEQUENCES**

- Soil Erosion & Land Degradation
- Depletion of natural resources
- Lower productivity
- Ground Water Depletion
- Shortage of Drinking Water
- Reduction in Species Diversity
- Increase in the extent of Wastelands

# Forest Resource of India

**Forest Cover of India**



India has 21 Percent of her geographical area under forest cover. According to the State Forest Report 2009, in the last 10 years, forest cover in the country has increased by 3.31 million hectares, showing an average 0.46% increase every year. The total forested area in India is about 63.73 million hectares. These forests supply a wide variety of resources. They provide structural timber and wood for making furniture and pulp, match wood, wood for charcoal, gum, resins, canes and fibres. Besides these, there are many other forest products such as leaves, fruits, tan dyes, medicinal herbs, bee-wax, honey, turpentine oil and lac.

## **Problems of Forestry and their Solution**

Indian Forestry faces many problems. Over grazing and forest fire often destroy forests. Reckless cutting of the trees causes forest destruction. Jhum cultivations destroy forest; it invites soil erosion. To preserve the forest, the Govt. of India has taken up a series of programmes: The forests are declared as Reserved Forests. The government has chalked out a good programme of 'Van Mahatsov'. Thousands of trees are planted every year in the months of July and August to promote new forestation. The Forest Research Institute has been set up at Dehra Dun for the promotion and preservation of the forests properly.

# Climate of India

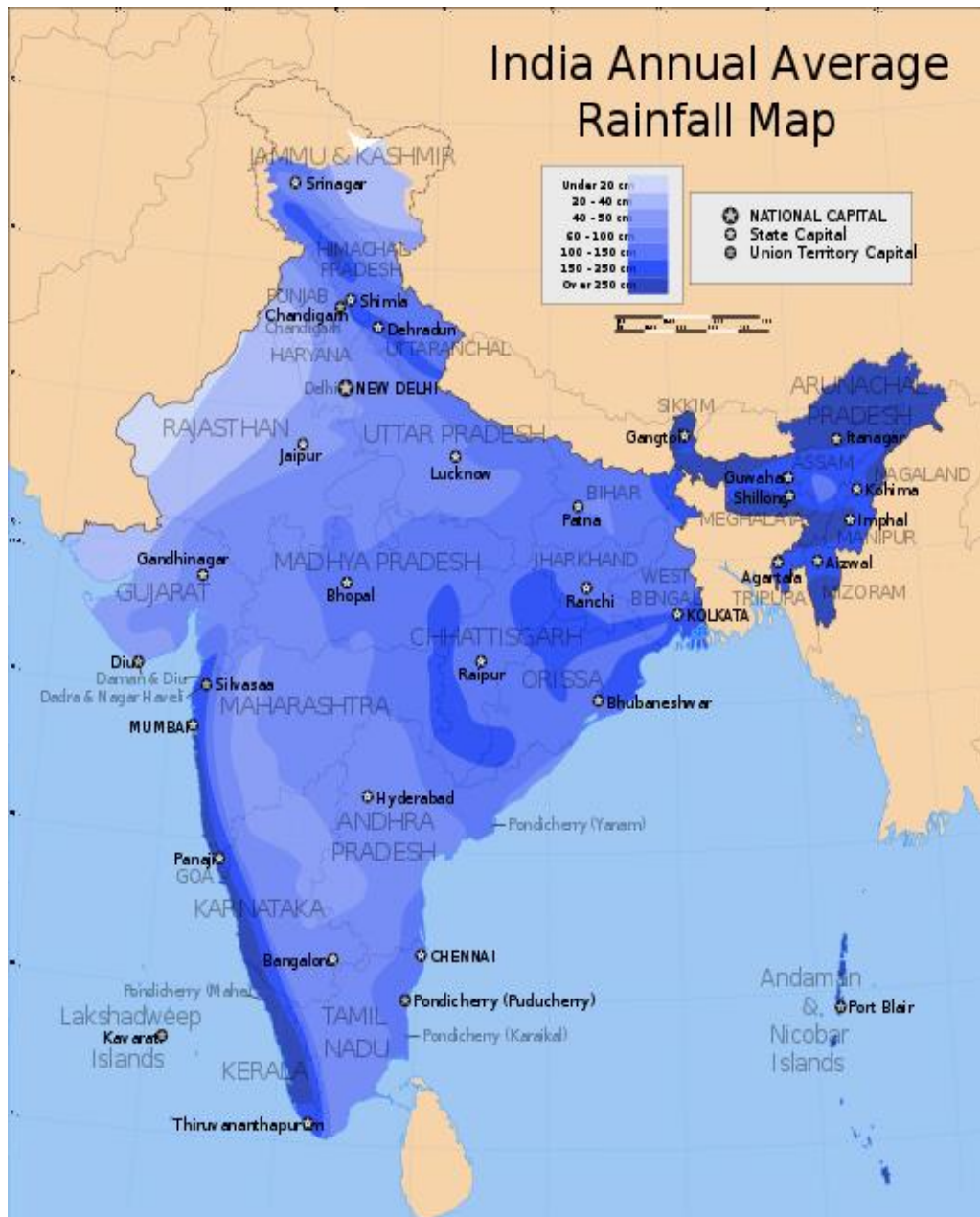
## TROPICAL MONSOON CLIMATE

India is a vast country and has different relief features. They are responsible for varied climatic conditions. India has very hot and very cold regions as well as regions with very heavy rainfall and very scanty rainfall. A large part of India has tropical monsoon climate. The climate of India has been influenced by its position, size and relief features. Monsoon winds are the main factors that determine the climate of India. They influence a large part of India. The Climate of India may be divided into four seasons-

- 1) Winter - From December to February(winter rains)
- 2) Summer - From March to May
- 3) South-West monsoons or rainy season - June to September
- 4) Retreating monsoons - October and November(tropical cyclones)

**DISTRIBUTION OF RAINFALL:** The rainfall in India is seasonal, uncertain and unevenly distributed. Most of the rain comes during the South-West Monsoon period. Rainfall may be too much or too little. There are also long dry periods in between. On the basis of the quantity of rainfall, we can divide India into five major rainfall regions.

- 1)Very low rainfall region (Less than 30 cms per year). It is found in Karakoram ranges, northern Kashmir and western parts of Kachchh and Rajasthan (Thar desert).
- 2) Low rainfall region (30 cms. to 60 cms. per year). It is found in Zaskar range, parts of Punjab and Haryana, Central Rajasthan, Western Gujarat and the rain-shadow areas of the Western Ghats.
- 3) Moderate rainfall (60 cms. to 100 cms. per year). It is found over a greater part of India, excluding the areas of low rainfall and heavy rainfall. Most of the rain is from the South-West Monsoon winds.
- 4) Heavy rainfall region (100 cms. to 200 cms. per year). It is found in four separate areas, including a narrow belt of the western coast, eastern coastal belt, the foothills of the Himalayas and a part of north-east India.
- 5) Very heavy rainfall region (over 200 cms. per year). It is found on the western side of the Western Ghats , the foothills of Himalayas, Meghalaya plateau (Shillong plateau) and Andaman and Nicobar Islands. Mawsynram in Meghalaya plateau has recorded 1141 cms. of rainfall per year and it is the place which gets the heaviest rainfall in India/world.



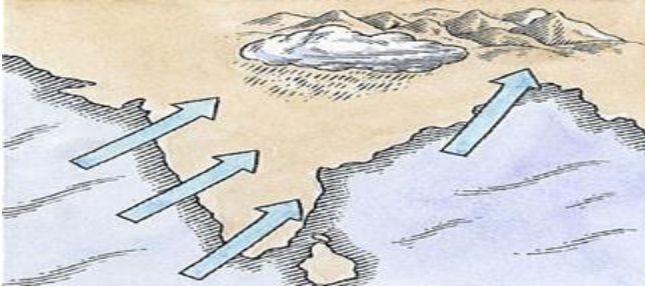
Climate plays a very important role on the economic development of a nation. The South-West Monsoons control the agriculture of India, which is the main occupation of the people. When the monsoons fail, there is drought, and the crops also fail. When the monsoons are heavy, there are floods, they also cause destruction to life and property. Hence, it is called that, “the Indian agriculture is a gamble with the Monsoons”.

## **SUMMER MONSOON OF INDIA(SW MONSOON)-**

Monsoon is seasonal changes in atmospheric circulation and precipitation associated with the asymmetric heating of land and sea.

The southwest monsoon brings rains towards the end of summer as the high pressure built in the Indian Ocean pushes the wind masses towards the low pressure formed on land. It's the temperature variation between the sea and the landmass – **Temperature Gradient**.

### **ACTION OF SOUTH WEST MONSOON IN INDIA:**



The southwest monsoon arrives in two branches: the Bay of Bengal branch and the Arabian Sea branch. The latter extends toward a low-pressure area over the Thar Desert and is roughly three times stronger than the Bay of Bengal branch. The southwest monsoon typically breaks over Indian Territory by around 25 May, when it lashes the Andaman and Nicobar Islands in the Bay of Bengal. It strikes the Indian mainland around 1 June near the Malabar Coast of Kerala. By 9 June, it reaches Mumbai; it appears over Delhi by 29 June. The Bay of Bengal branch, which initially tracks the Coromandal Coast northeast from Cape Comorin to Orissa, swerves to the northwest towards the Indo-Gangetic Plain. The Arabian Sea branch moves northeast towards the Himalayas. By the first week of July, the entire country experiences monsoon rain; on average, South India receives more rainfall than North India. However, Northeast India receives the most precipitation. Monsoon clouds begin retreating from North India by the end of August; it withdraws from Mumbai by 5 October. As India further cools during September, the southwest monsoon weakens. By the end of November, it has left the country.

The southwest monsoon, a four-month period when massive convective thunderstorms dominate India's weather, is Earth's most productive wet season. A product of southeast trade winds originating from a high-pressure mass centered over the southern Indian Ocean, the monsoonal torrents supply over 80% of India's annual rainfall. Attracted by a low-pressure region centered over South Asia, the mass spawns surface winds that ferry humid air into India from the southwest. These inflows ultimately result from a northward shift of the local jet stream, which itself results from rising summer temperatures over Tibet and the Indian subcontinent. The void left by the jet stream, which switches from a route just south of the Himalayas to one tracking north of Tibet, then attracts warm, humid air. The main factor behind this shift is the high summer temperature difference between Central Asia and the Indian Ocean. This is accompanied by a seasonal excursion of the normally equatorial intertropical convergence zone, a low-pressure belt of highly unstable weather, and northward towards India.

## KEY ASPECTS AND BARRIERS:

1.Strikes at western ghats;and gives rainfall to the western most regions; while rainshadow interiors, thr Deccan plateau receives very less rainfall.

2.moves parallel with the eastern ghats and produce no rainfall until it strikes at NE.

3.Another current enters at kutch peninsula and gives medium rainfall to the Indo-Gangetic plains.

## NORTHEAST MONSOON-

Around September, with the sun fast retreating south, the northern land mass of the Indian subcontinent begins to cool off rapidly. With this air pressure begins to build over northern India, the Indian Ocean and its surrounding atmosphere still holds its heat. This causes the cold wind to sweep down from the Himalayas and Indo-Gangetic Plain towards the vast spans of the Indian Ocean south of the Deccan peninsula. This is known as the Northeast Monsoon or Retreating Monsoon.

While travelling towards the Indian Ocean, the dry cold wind picks up some moisture from the Bay of Bengal and pours it over peninsular India and parts of Sri Lanka. Cities like Madras, which get less rain from the Southwest Monsoon, receives rain from this Monsoon. About 50% to 60% of the rain received by the state of Tamil Nadu is from the Northeast Monsoon. In Southern Asia, the northeastern monsoons take place from December to early March when the surface high-pressure system is strongest. The jet stream in this region splits into the southern subtropical jet and the polar jet. The subtropical flow directs northeasterly winds to blow across southern Asia, creating dry air streams which produce clear skies over India. Meanwhile, a low pressure system develops over South-East Asia and Australasia and winds are directed toward Australia known as a monsoon trough.

## WESTERN DISTURBANCES-

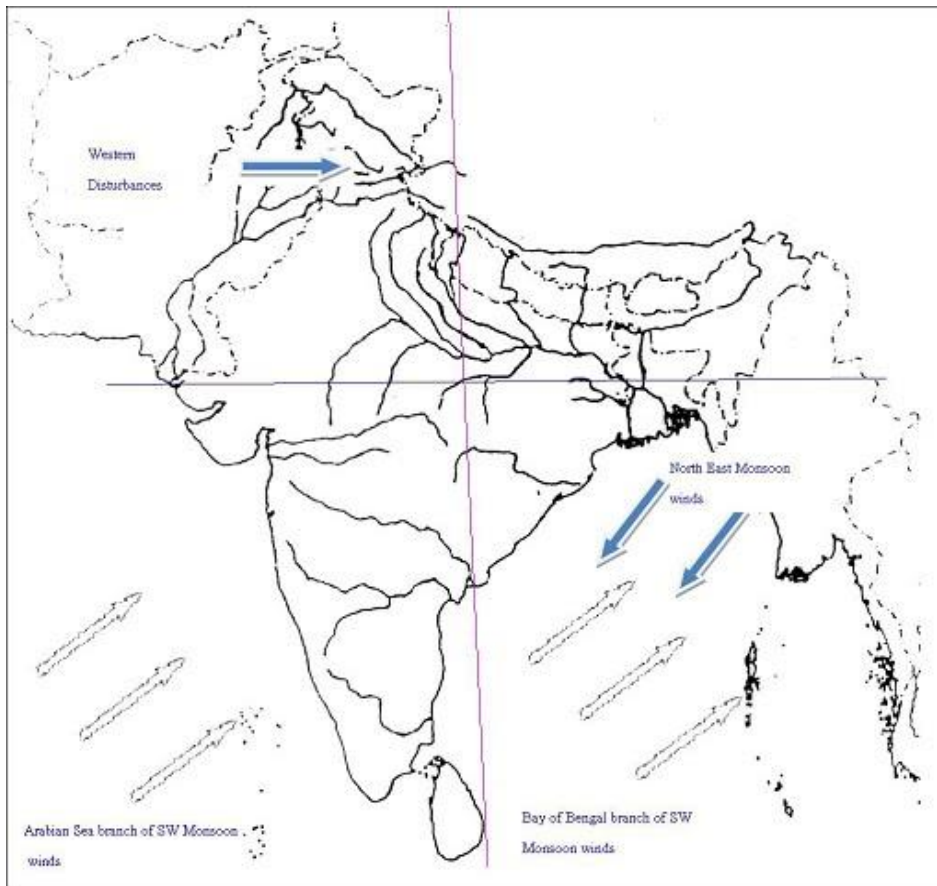
WD are the Temperate cyclones or extratropical storm originating in the Mediterranean, that brings sudden winter rain and snow to the northwestern parts of the Indian subcontinent. This is a non-monsoonal precipitation pattern driven by the Westerlies. The moisture in these storms usually originates over the Mediterranean Sea and the Atlantic Ocean. Extratropical storms are a global, rather than a localized, phenomena with moisture usually carried in the upper atmosphere (unlike tropical storms where it is carried in the lower atmosphere). In the case of the subcontinent, moisture is sometimes shed as rain when the storm system encounters the Himalayas.

Western Disturbances are important to the development of the Rabi crop in the northern subcontinent, which includes the locally important staple wheat.

**WINTER- RAINFALL-** occur due to-

- 1) NE Monsoons
- 2) Western disturbances
- 3) Tropical cyclones.





### FACTORS RESPONSIBLE FOR REGIONAL VARIABILITY OF RAINFALL OVER INDIA-

Geographical setting- windward regions (like western ghats) get more rainfall than interiors, regions obstructing monsoonal branches like those perpendicular to Arabian sea branch get rainfall while the south eastern region of India which is parallel to bay of Bengal branch remains dry. Aravallis parallel to Arabian sea branch remains dry. Also regions near to the sea get more rainfall as winds bear more moisture. The regions of the confluence of the 2 major branches also receive more rainfall.

### TROPICAL CYCLONES-

A tropical cyclone is a storm system characterized by a large low-pressure center and numerous thunderstorms that produce strong winds and heavy rain.

- Winds spiral at high speed -120kmph about a calm eye.
- Inner pressure could be as low as 890mb.
- Develop over sea where surface temperature is above 27 degree celcius.
- Acquire energy from the latent heat of condensation of water vapour.
- Form between 8-20 degree north and south of equator and never between 0-8 degrees north and south of equator because of weak coriolis force.

- Quickly dissipate over land as their moisture supply is cut off.
- Cause heavy rains with thunderstorms but rain is short lived.
- Most violent and destructible type of storms. Destruction caused by storm surge, high velocity winds and heavy rainfall.

### **SOUTHERN OSCILLATIONS-**

The Southern Oscillation is the see-saw pattern of reversing surface air pressure between the eastern and western tropical Pacific; when the surface pressure is high in the eastern tropical Pacific it is low in the western tropical Pacific, and vice-versa. Thus, the El-Niño Southern Oscillation(ENSO) is the result of a cyclic warming and cooling of the surface ocean of the central and eastern Pacific. This region of the ocean is normally colder than it's equatorial location would suggest, mainly due to the influence of northeasterly trade winds, a cold ocean current flowing up the coast of Chile, and to the upwelling of cold deep water off the coast of Peru.

At times, the influence of these cold water sources wane, causing the surface of the eastern and central Pacific to warm up under the tropical sun - this is an **EL-NIÑO** event. This results in heavy rainfall in South America, but severe droughts in eastern Australia. The more intense the El-Niño, the more intense and extensive the Australian droughts.

At other times, the injection of cold water becomes more intense than usual, causing the surface of the eastern Pacific to cool - this is a **LA-NIÑA** event. This results in droughts in south America and heavy rainfall, even floods, in eastern Australia. In this way, Australia experiences it's characteristic cycle of droughts and floods - all caused by the El-Niño/La-Niña cycle described above.

### **MANGO SHOWERS-**

Mango showers are the pre-monsoon showers in the Indian states of Karnataka and Kerala that help in the ripening of mangoes. Also known as April rains or Summer showers, they are a result of thunderstorms over the Bay of Bengal. These summer rains normally come in the second half of the month of April, though the arrival is difficult to predict. The showers prevent the mangoes from dropping prematurely from trees and are crucial for the mango cultivators of South india.

### **CHERRY BLOSSOMS-**

In Karnataka and associated region the local thunderstorms are called as cherry blossoms. This is caused due to the meeting of humid sea winds and hot dry local wind. It occurs in the month of april & may. These showers help in the ripening of coffee plants.

### **NORWESTERS-**

These are the shallow cyclonic disturbances that travel to India from Mediterranean sea and Persian gulf that cause rainfall in the east India- Assam, W.Bengal, Orissa during winter season.

## Soils in India

### SOIL?

Soil is the uppermost layer of Earth's crust.

Soil is the medium in which plants grow and thus it supports the lives on earth.

### Factors that control the formation of soil-

A number of factors contribute to the soil formation and fertility.

1. Parent rocks: - the rock on which the soil is formed decomposes and disintegrates under the processes of weathering. The characteristics of rocks influence the characteristics of soils. For example on lava rocks black soils and iron oxide rich rocks red soils are formed.

2. Climate: - climate influence the rate of weathering of rocks and type of vegetation, thus these influence the characteristics of soils.

3. Slope: - the nature of relief and slope influence the accumulation of soils. Mountains have thin soil cover but the plains have thick soil cover.

4. Time: - time provides maturity to the soil.

5. Various forces of nature such as change in temperature, actions of running water, wind and glaciers, activities of decomposers etc. contribute to the formation of soil.

6. Chemical and organic changes which take place in the soil are equally important.

**The soils of India on the basis of their formation are divided in the following two broad categories-**

1. Residual Soil- which form at the place of their origin. Like – black soils

2. Transported Soil- which are transported from place of their formation. Like alluvial soils.

**The major soil groups are:**

### 1) BLACK SOIL

- Black soil is made from lava-solidified rocks and is also called as 'Black Cotton Soil' or 'Regur Soil'.

The black colour of regur soil is due to its iron content, deriving from plutonic lava materials.

Mainly found in the Deccan region which includes the major part of Maharashtra, Gujarat and part of Tamil Nadu, Andhra Pradesh and Madhya Pradesh.

Cotton is most important crop grown on this soil.

CHARACTERISTICS-

- Clayey, deep and impermeable

- They swell and become sticky when wet and shrink when dried
- During dry season, these soils develop wide cracks.
- Rich in lime and iron, magnesia and alumina
- Also contain potash
- Lack phosphorus, nitrogen and organic matter
- Very clayey and therefore highly retentive of water. Because of high clay content, these soils expand when wet and become difficult to plough.
- During dry season, black soils shrink and develop big cracks which help in air circulation.
- Dark in colour, suitable for cotton cultivation are residual soils.

Spread over an area of 5.4 sq. km., i.e. 16.6 % of the total land area of the country.

## 2) RED SOIL

- These soils are found in Chhotanagpur plateau, Telangana, Nilgiris, Tamil Nadu, Karnataka, Andhra Pradesh and periphery areas of Deccan Plateau. These soils have been formed due to decomposition of underlying igneous rocks under heavy rainfall. These are suitable for the cultivation of millets, pulses, Linseed, tobacco etc. These soils are poor in Lime, Nitrogen and humus.

### CHARACTERISTICS:

Red soils are reddish in colour due to the presence of iron. Formed due to weathering of ancient crystalline and metamorphic rocks.

- Parent rocks are acid granites and gneisses.
- Occupy an area of about 3.5 lakh sq km – 10.6% of the total land area of the country .
- These are transported type soils.
- Are mostly light to dark colour depending on new or old alluvium.
- Rich in potash and become fertile with the proper use of fertilizers and irrigation.
- Deficient in nitrogen, lime, magnesia, humus and phosphate
- Red due to its very high iron content.
- Are porous, friable in nature .
- Loose and aerated.

Contains soluble salts in small quantities.

### 3) LATERITE SOIL

- laterite = brick (Latin word)

These soils are formed under conditions of high temperature and heavy rainfall with alternate wet and dry periods. Thus its formation takes place strictly under monsoon conditions.

Residual soils formed by leaching in areas of heavy rain.

Leaching is a process in which the nutrients get percolated down below the soil due to heavy rainfall; thus leaving the top soil infertile. Also called DESILICATION.

Laterite soils are found in elevated areas which receive very high rainfall

As a result, top soil gets washed away. This process is called leaching. The soil, therefore, loses its fertility to a great extent.

It covers an area of about 2.4 lakh sq km. These soils are found in the north- eastern state of Meghalaya in India. Laterite soils are found on the highland areas of the plateau. These are found in Karnataka, Kerala, Tamil Nadu and hilly regions of Assam, Rajmahal hills and Chhotanagpur plateau. These are shallow, acidic and less fertile soils. These soils are poor in lime but rich in iron. So these are suitable for plantation of crops like tea, rubber, coffee etc.

- Is of coarse texture, soft and friable.
- Is red due to the presence of iron oxide which is formed by leaching. The soluble plant foods like potash are removed from the top soil leaving alumina and iron oxide.
- Is a porous soil, silica is removed from it by chemical action. Is poor in lime and magnesium, and deficient in nitrogen.

### 4) ALLUVIAL SOIL

- (Riverine soil)

It covers about 40 percent of land area of the country. They are depositional soils, transported and deposited by rivers and streams. These soils are formed by the deposition of fine sediments and silt by the rivers along their banks. In India, alluvial soils are mostly found in the Great Northern Plains, the coastal plains and river deltas.

They can be divided into two types:

1. Young Khadar soils: these are newer alluvium of sandy, pale brown composition, found in lower areas of valley bottom which are flooded almost every year. It is non porous, clayey and loamy.

2. Old Bhangar soils: these consist of older alluvium of clayey composition and are dark in colour.

They are coarse in nature, contain kankar (lime nodules), pebbles, gravels. They are found 30 m above flood level of the rivers.

They represent the 'riverine alluvium' brought down by Sutlej, Yamuna, Ghagra and other rivers of Indo-Gangetic Plains.

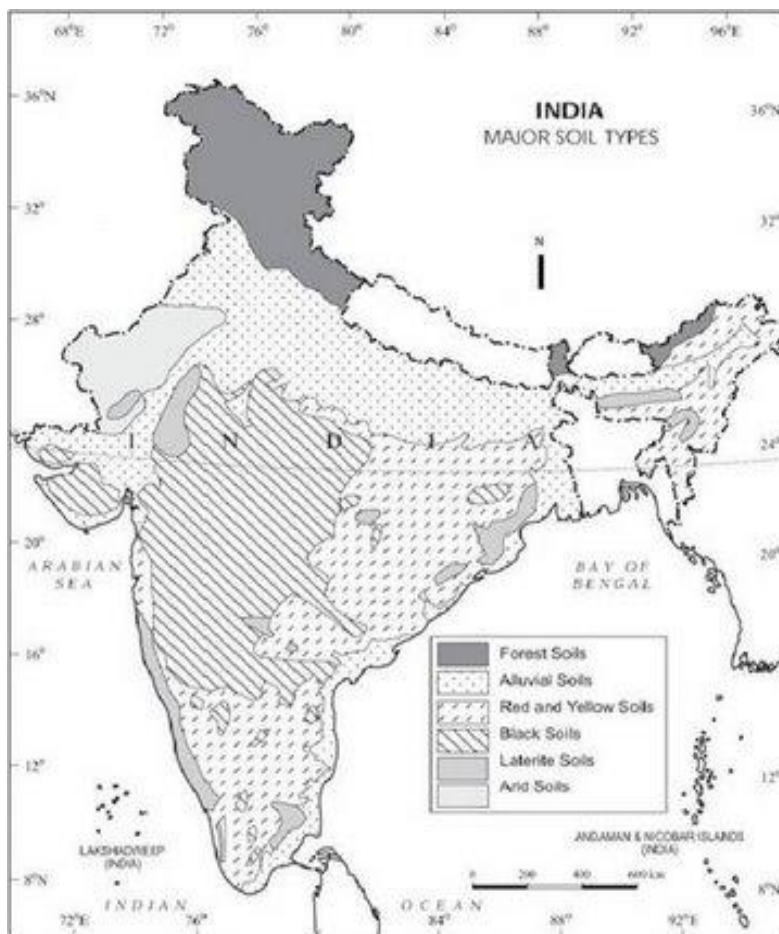
These soils are the most widespread soils covering an area of 8 lakh sq. km from Punjab to Assam. These are found in the river basin, flood plains and coastal areas. These soils are covering 22.16 per cent of total area of India.

Alluvial soils though differ greatly in texture, are very fertile on whole. They:

- Respond well to irrigation and manuring.
- Good for both rabi and kharif crops.
- Suitable for wheat, sugarcane, rice, cotton and oilseeds.
- In delta region, they are ideal for jute cultivation.

Useful for agriculture since it is fertile.

Soil is rich in potash and lime but poor in nitrogen and humus.



NOTE\*- THE AFOREMENTIONED FOUR SOILS – BLACK, RED, LATERITE AND ALLUVIAL ARE GENERALLY ASKED IN MAINS.

Other Soils: The other soils in the category of the Indian soils are as follows:

## **MOUNTAIN SOILS:**

Mountain soils are found in, as the name suggests, in mountainous regions. They are quite prone to soil erosion as a result of the top soil getting washed away due to the steep slopes of the mountains after a period of heavy rainfall.

These soils are mostly thin and infertile. These include peat, meadow and forest hill soils. The major characteristics of this soil are:

- They are rich in humus
- Are coarse and infertile. They are deficient in potash, phosphorous and lime.
- Tea, coffee, spices and tropical fruits

The states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand, Assam, Sikkim as well as higher reaches of Arunachal Pradesh have mountain soil.

## **ARID AND DESERT SOILS**

Large part of arid and semi-arid region of Rajasthan and adjoining areas of Punjab and Haryana Desert soils are found in arid regions which receive very little rainfall.

- Low rainfall and high temperature are reasons for the formation of this soil.
- Having less than 50 cm rainfall . The high temperature adds to the loss of any remaining moisture in the soil. The soil is therefore sandy in nature. Thar Desert in Rajasthan has sandy soil.
- Covers an area of about 1.4 lakh sq km
- Originated from the mechanical disintegration of the ground rock of by deposition by wind
- Desert soil contain 90% of sand and 5% of clay. It contains rich percentage of soluble salts, but lack in organic matter.
- Are porous and coarse.
- They respond well to irrigation and manuring , especially phosphate and nitrate.- it can improve the soil fertility as it is seen in the case of Indira Gandhi Canal in Rajasthan.
- Only suitable for drought resistance crops like millets, barley, cotton, maize and pulses.

## **SALINE AND ALKALINE SOILS**

Soils with high proportion of salts and alkalis are called saline and alkaline soils . They are formed due to accumulation of tidal water in adjoining coasts where drainage is poor. They are found in drier parts of Bihar, Rajasthan, U.P., Punjab, Haryana, Maharashtra. These soils contain many salts like sodium, magnesium and calcium which make them infertile and render unfit for agriculture.

## **MARSHY SOIL**

Found in continuously water-logged areas, or marshy areas especially in the coastal regions near the sea or near the deltas.

- It covers about 56,000 sq km.
- They are formed as a result of water-logging
- It contain iron and varying amount of decayed organic matter.
- Found in southern parts of Siwaliks, Jammu and Kashmir, U.P.

## **SOIL EROSION**

### **Soil- erode-**

when topmost fertile layer of the soil become loose and gets eroded/washed away with the action of wind or water.

### **Common Causes-**

- Deforestation
- Over-grazing
- Action of wind, water, glacier, etc.
- Faulty methods of agriculture, over-irrigation, shifting agriculture, wrong ploughing, etc.
- Other anthropogenic factors(mining activities, industrial activities, etc).

### **CAUSES OF SOIL EROSION IN INDIA-**

- 1) Heavy population pressure on land: - forest cover as low as 20.55% of total area – population continues to rise at a rapid rate – more forests are destroyed – heavy pressure on land.
- 2) Nature of Rainfall:- receives 80 to 90 per cent of rainfall in the monsoon season. – heavy downpour during monsoon months causes floods. - remaining months – droughts – these affect soils.
- 3) Overgrazing – number of domestic animals, esp cattle highest in world – cattle freely graze in open lands making them bare of vegetation-winds carry away dry soil particles – Rajasthan
- 4). Bad farming techniques – plough fields in traditional ways – small size of holdings, absence of terracing, contour cultivation, crop rotation, improper use of manure have caused erosion
- 5) Topography – North –Eastern parts of India, Shivaliks and the hilly regions in south India are affected by soil erosion because of steep slopes and heavy rainfall. During heavy rainfall, soils are washed away by running water down the slope.
- 6) Deforestation: destruction of forests for cultivation – cutting of trees exposes the soil to water and wind which leads to soil erosion



## REGIONS OF SOIL EROSION

\*Rajasthan, Madhya Pradesh, Maharashtra, UP, Gujarat, Andhra Pradesh, Karnataka. Worst affected areas include:

- \* The badlands of Chambal and Yamuna rivers
- \* The piedmont zone of the western Himalayas
- \* The Chotanagpur plateau region
- \* The Tapi-Sabarmati valley region in Gujarat
- \* The regur soil area of Maharashtra
- \* The dry areas of Rajasthan, Gujarat and Haryana

## EFFECTS OF SOIL EROSION:

- \* Loss of fertile top soil
- \* Lowering of the underground water table and decreasing soil moisture
- \* Drying of vegetation and extension of arid lands, increase in the frequency of droughts and floods
- \* Silting of river and canal beds, Recurrence of landslides, adverse effect on economic prosperity and cultural development
- \* Wind erosion reduces the productive capacity of soil, as most of the nutrients required by the plants are carried by the wind.

## PREVENTION OF SOIL EROSION-

1. *Terrace Farming*:- On hilly slopes, terraces act as bunds and prevent the soil from being washed away.

2. *Contour ploughing*- Ploughing along contour on a slope prevents soil being washed away by rainwater or by surface run off. Contours act like bunds. Terraces are levelled into step like small fields with even slope.

3) *Afforestation*: planting of trees along the edges of the fields, the waste land and on steep slopes to prevent soil erosion as well as to enhance the capacity of the soil to retain water.

\* increase area under forests and indiscriminate felling of trees must stop.

4) *Shelter Belts*: Farmers plant trees in several rows to check wind erosion. Known as wind breaks.

5) *Strip cropping*: Crops are grown in alternate strips of land to check the impact of the winds.

6) *Construction of dams*: Rivers cause soil erosion. Dams are built in the upper course of rivers to control erosion of soil. This would check the speed of water and thereby save soil from erosion.

7) *Ploughing Gullies*: The gullies made in the soil are plugged with deposition of silt during heavy rains.

8) Shifting or Jhuming or slash and burn type of agriculture should be banned.

## **SOIL CONSERVATION SCHEMES**

1. The centrally sponsored scheme of Integrated Watershed Management in the catchments of flood-prone rivers was launched during sixth Plan in eight flood-prone rivers of the Gangetic Basin covering seven States and one Union Territory. It aims at enhancing the ability of the catchment by absorbing larger quantity of rainwater, reducing erosion and consequent silt load in the stream and river beds and thus helping to mitigate the fury of floods in the productive plains.

2. A scheme for reclamation and development of ravine areas was launched in 1987-88 in MP, UP and Rajasthan. – included prepheral bunding to halt further ingress of ravines, afforestation of ravines, aforestaton of ravines for fuel, fodder and reclamation of shallow ravines.

3. Control of shifting cultivation is implemented since 1994-95 in the States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, Tripura

The integrated programme envisages settling of families practising shifting cultivation.

it helps them to practise terraced cultivation, raising of horticultural palantations and afforestation to support animal husbandry and to meet fuel and fodder requirements.

4) In urban areas, rain water harvesting is means of checking soil erosion, besides recharging ground water.

## Drainage system of India



The origin of the **rivers in India** comprises three prime watersheds:

- Himalayas and the Karakoram ranges
- Vindhya, Satpura ranges and the Chota Nagpur Plateau
- Western Ghats

**Indian Rivers are classified into four categories on the basis of their origin. They are**

1. Himalayan Rivers
2. Deccan Rivers
3. Coastal Rivers and
4. Rivers of the inland Drainage basin

#### **DIFFERENCE BETWEEN HIMALAYAN AND PENINSULAR RIVERS-**

##### **HIMALAYAN DRAINAGE-**

- Antecedent drainage i.e. Himalayan rivers are older than lesser Himalayas and shivaliks (older than the structures they cut across).
- Nature of flow is perennial- fed by rain and melting glaciers.
- Geologically young
- Long courses
- Flow through loose alluvial soils of northern plains
- Form deep valley and gorges due to intensive erosion.
- Generate large quantities of sediment.
- Cause annual flooding.
- Nature of river course is quiet changing, meandering , forming ox-bow lakes, high waterfalls, deeper basins and large catchment areas and form deltas.

##### **PENINSULAR DRAINAGE-**

- Super-imposed drainage i.e. regional structures are older than the river valleys that cut through them.
- Nature of flow is seasonal- during sw monsoons.
- Geologically older.
- Shorter courses.
- Flow through hard granitic soils of peninsular India.
- Shallow graded valleys with little erosion.
- Shallow valleys, small waterfalls, deltas and estuaries.

#### **DIFFERENCE BETWEEN WEST FLOWING RIVERS AND EAST FLOWING RIVERS OF PENINSULAR INDIA-**

WEST FLOWING- Narmada, Tapi , etc

- Flow into Arabian sea
- Through rift valley in straight linear course

- Do not have extensive network of tributaries
- Geologically young
- Generally form estuaries and not deltas
- Their valley floors much above the sea level
- Flow swiftly into the sea.

EAST FLOWING- Mahanadi, Godavari, Krishna, Cauvery, etc

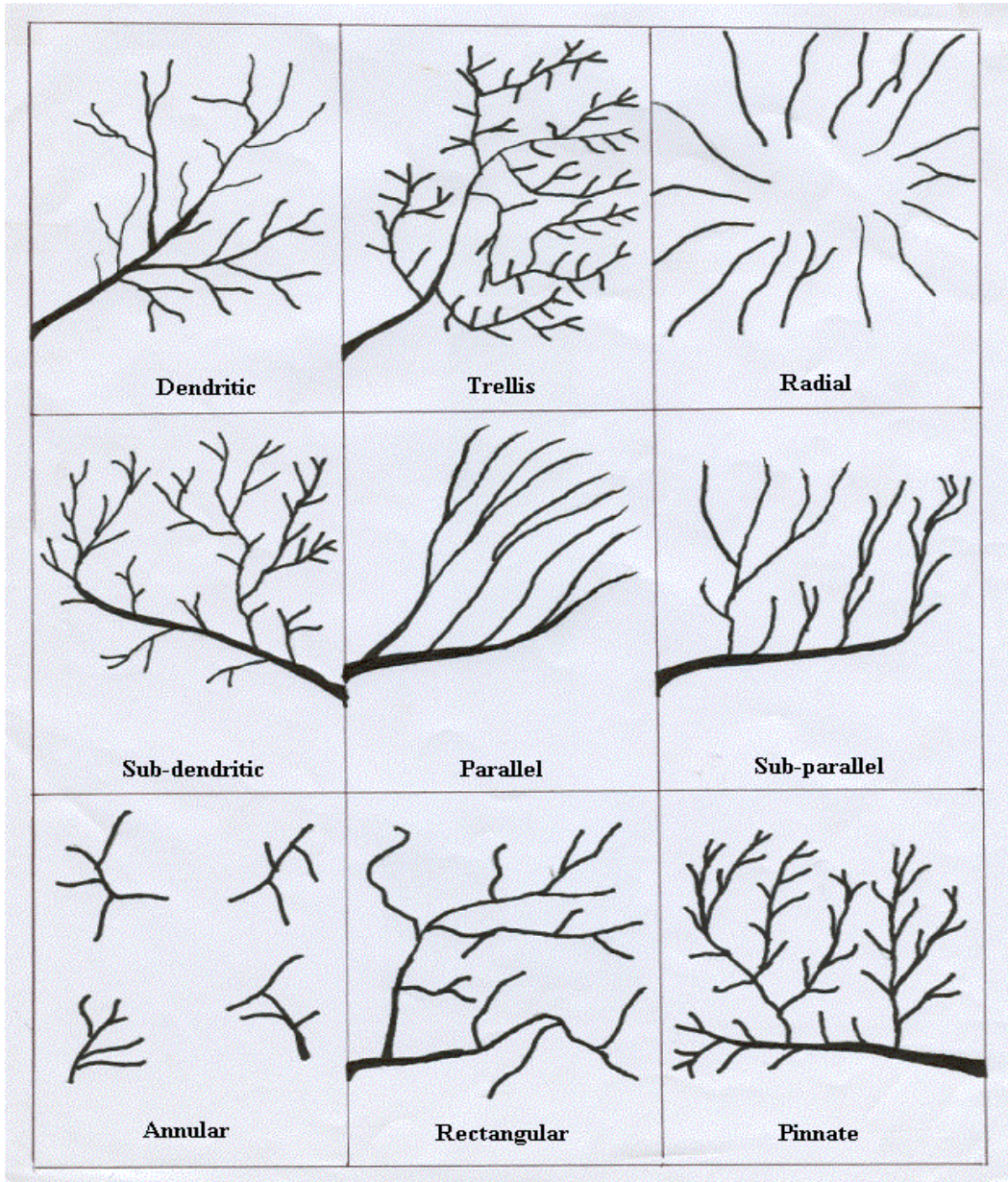
- Flow into bay of Bengal
- Have extensive network of tributaries
- Geologically old
- Have large catchment areas and form deltas
- Their valley floors at sea level
- Flow sluggishly into the sea.

### STREAM PATTERNS-

Drainage basin (drainage basin is equivalent term to watershed, catchment) is the area drained by tributary streams that coalesce into a main channel. The line, which divides the surface runoff between two adjacent river basins, is called the topographic water divide, or the watershed divide. The divide follows the ridgeline around the basin crossing the stream only at the outlet point. It marks the highest points between the basins, but isolated peaks within a basin may reach higher elevations than any point on the divide. The combined effects of climate and geology on the catchment topography yield an erosion pattern, which is characterized by a network of streams. Some of the frequently observed stream patterns are:

- Dentric:** When a region is homogenous offering no variation in the resistance to the flow of water, the resulting streams run in all directions without definite preference to any one particular region.
- Trellis:** The trellis drainage pattern develops when the underlying rock is strongly folded or sharply dipping. The longer streams will have preference to one particular orientation and the other tributaries will have an orientation and the tributaries will have an orientation at right angles to this.
- Radial:** The drainage pattern from dome mountains and volcanoes is of radial type where the streams emanate from a central focus and flow radially outward.
- Parallel and Sub parallel:** The internal geological structure of the land, sometimes the parallel and sub parallel patterns are formed. The most of the streams run in the same direction is the main characteristic feature.
- Annular:** The streams, which form in the weaker strata of the dome mountain, indicate approximately circular or annular pattern. The annular pattern may be treated as a special form of trellis pattern.
- Rectangular:** A region consisting of many rectangular joints and faults may produce a rectangular drainage pattern with streams meeting at the right angle.

vii. Pinnate: In pinnate stream pattern, all the main streams run in one direction with the tributaries joining them at an oblique angle



#### NATIONAL WATERWAYS-

**Inland Waterways Authority of India (IWAI)** was created by Indian Government on 27 October 1986 for development and regulation of Inland Waterways for shipping and navigation.

We have 6 national waterways in or country-

- 1) National waterway 1  
Allahabad — Haldia stretch of the Ganga-Bhagirathi-Hooghly river system.  
Estd = October 1986.  
Length = 1620 km
- 2) National waterway 2  
Sadiya — Dhubri stretch of Brahmaputra river.  
Estd = September 1982.  
Length = 891 km
- 3) National waterway 3  
Kottapuram-Kollam stretch of the West Coast Canal, Champakara Canal and Udyogmandal Canal.  
Estd = February 1993  
Length = 205 km
- 4) National waterway 4  
Kakinada - Puducherry stretch of Canals and the Kaluvelly Tank, Bhadrachalam – Rajahmundry stretch of River Godavari and Wazirabad – Vijayawada stretch of River Krishna.  
Estd = November 2008  
Length = 1095 km
- 5) National waterway 5  
Talcher - Dhamra stretch of the Brahmani River, the Geonkhali - Charbatia stretch of the East Coast Canal, the Charbatia - Dhamra stretch of Matai river and the Mangalgadi - Paradip stretch of the Mahanadi River Delta.  
Established = November 2008  
Length = 623 km
- 6) National waterway 6  
Lakhipur to Bhanga of river Barak.  
Proposed  
Length = 121 km

#### **INTER-LINKING OF RIVERS-**

Massive project to interlink major Indian rivers by constructing canals to reduce the risk of flood and to transport water from surplus to deficient areas.

Plans for parts of the Indian Rivers Inter-link were mooted in the British period. In 1972 the then Minister for Irrigation K. L. Rao proposed a 2640 kilometer long link between the Ganges and Cauvery rivers. In 1974 plans were proposed for the Garland canal. In 1982 the National Water Development Agency was set up to carry out surveys of the links and prepare feasibility studies.

## Project?

The Inter-link would consist of two parts, a northern Himalayan River Development component and a southern Peninsular River Development component.

### Present Proposals-

In India 30 links have been identified as technically feasible and economically viable on the basis of pre-feasibility studies. These are: Mahanadi (Manibhadra – Godavari (Dowlaiswaram) link, Godavari (Inchampalli Low Dam) – Krishna link, Godavari (Inchampalli) – Krishna (Nagarjunasagar) link, Godavari (Polavaram) – Krishna (Vijayawada) link, Krishna (Almatti) – Pennar link, Krishna (Srisaillam)- Pennar link, Krishna (Nagarjunasagar) – Pennar (Somasila) link, Pennar (Somasila) –Cauvery (Grand Anicut) link, Cauvery (Kattalsi)- Vaigai-Gundar link, Ken-Belwa link, Parbati-Kalisindh-Chambal link, Par-Tapti-Narmada link, Damanganga-Pinjal link, Bedti-Varda link, Netravati-Hemavati link and Pamba-Achankovil-Vaippar link.

Similarly, based on various water balance studies carried out for the Himalayan component, the link proposals identified for preparation of feasibility reports include the Manas-Sankosh-Tista-Ganga link, Kosi-Ghagra link, Ghagra-Yamuna link, Sarada-Yamuna link, Yamuna-Rajasthan link, Rajasthan-Sabarmati link, Chunar-Sone Barrage link, Sone Dam – Southern Tributaries of Ganga link, Ganga-Damodar-Subernarekha link, Subernarekha-Mahanadi link, Kosi-Mechi link, Farakka-Sunderbans link, and Jogigopa-Tista-Farakka link

### BENEFITS-

- 1) Greatly reduce the regional imbalance in the availability of water in different river basins. Surplus water which flows waste to the sea would be fruitfully utilized. It is assessed that the inter-linking of rivers will provide additional irrigation benefits to 35 million hectares (Mha) -25 Mha from surface water and an additional 10 Mha from increased ground water recharge- which will be over and above the ultimate irrigation potential of 140 Mha envisaged from the conventional irrigation projects.
- 2) Construction of storage dams as proposed will considerably reduce the severity of floods and the resultant damages. The flood peaks are estimated to reduce by about 20 to 30 per cent in the Ganga and Brahmaputra basins.
- 3) The benefits of drought mitigation from inter-basin water transfers will accrue to an area of about 25 lakh hectares in West Bengal, Bihar, Jharkhand, Uttar Pradesh, Haryana, Rajasthan, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu.
- 4) Hydro power could also be generated on a massive scale by the storage dams proposed under the interlinking of rivers. Hydro power development has not kept pace with the potential and requirement in our country. Against a potential of 84,000 MW, only about 22,000 MW capacity for hydro power generation has been developed so far. The storage dams proposed under interlinking of rivers will greatly improve this situation. The total hydro power potential of the interlinking systems is estimated to be 34,000 MW.



- 5) Most of the mega cities and urban centres in our country are already suffering from water shortages. A major part of the future requirements of big cities will have to be met from long-distance inter-basin transfer of water. In the link proposals under study, water supply to Mumbai and Delhi and many other villages and habitations enroute the link canals are proposed to be raised.

#### **ISSUES-**

- 1) Very expensive
- 2) Possibility of extensive environmental and ecological damage
- 3) Problem of land-acquisition
- 4) Inter-state disputes
- 5) Maintenance problems & cost
- 6) Siltation of canals

#### **RIVER WATER POLLUTION-**

Most of the Indian rivers and their tributaries viz., Ganges, Yamuna, Godavari, Krishna, Sone, Cauvery Damodar and Brahmaputra are reported to be grossly polluted due to discharge of untreated sewage disposal and industrial effluents directly into the rivers. These wastes usually contain a wide variety of organic and inorganic pollutants including solvents, oils, grease, plastics, plasticizers, phenols, heavy metals, pesticides and suspended solids. The indiscriminate dumping and release of wastes containing the above mentioned hazardous substances into rivers might lead to environmental disturbance which could be considered as a potential source of stress to biotic community.

As for example, River Ganges alone receives sewage of 29 class I cities situated on its banks and the industrial effluents of about 300 small, medium, and big industrial units throughout its whole course of approximately 2525 kms. Identically Yamuna is another major river, has also been threatened with pollution in Delhi and Ghaziabad area. Approximately 5,15,000 kilolitres of sewage waste water is reported to be discharged in the river Yamuna daily. In addition, there are about 1,500 medium and small industrial units which also contribute huge amounts of untreated or partially treated effluent to the river Yamuna every day.

Similarly many other rivers were surveyed during past two decades with respect to their pollutional status. In addition to domestic and industrial discharge into the rivers, there were continued surface run off of agricultural areas, mines and even from cremation on the river banks. According to a report, over 32 thousand dead bodies were cremated at the major burning Ghats per year in Varanasi alone in the year 1984.

#### **IMPACT OF RIVER WATER POLLUTION-**

The pollutants include oils, greases, plastics, plasticizers, metallic wastes, suspended solids, phenols, toxins, acids, salts, dyes, cyanides, pesticides etc. Many of these pollutants are not easily susceptible to degradation and thus cause serious pollution problems. Contamination of ground water and fish-kill episodes are the major effects of the toxic discharges from industries. Discharge of untreated sewage and industrial effluents leads to number of conspicuous effects on the river environment. The impact involves gross changes in water quality viz. reduction in dissolved oxygen and reduction in light penetration that's tends loss in self-purification capability of river water.

**Environmental implications of the discharge of sewage and industrial effluents**

<b>S.N.</b>	<b>Factor</b>	<b>Principal environmental effect</b>	<b>Potential ecological consequences</b>	<b>Remedial action</b>
1.	High biochemical oxygen demand (BOD) caused by bacterial breakdown of organic matter	Reduction in dissolved oxygen (DO) concentration	Elimination of sensitive species, increase in some tolerant species; change in the community structure	Pretreatment of effluent, ensure adequate dilution
2.	Partial biodegradation of proteins and other nitrogenous material	Elevated ammonia concentration; increased nitrite and nitrate levels	Elimination of intolerant species, reduction in sensitive species	Improved treatment to ensure complete nitrification; nutrient stripping possible but expensive
3.	Release of suspended solid matter	Increased turbidity and reduction of light penetration	Reduced photosynthesis of submerge plants; abrasion of gills or interference with normal feeding behaviour	Provide improved settlement, insure adequate dilution
4.	Deposition of organic sludge in slower water	Release of methane and hydrogen as sulphide matter decomposes anoxically, Modification of substratum by blanket of sludge	Elimination of normal benthic community loss of interstitial species; increase in the species able to exploit increased food source	Discharge where velocity adequate to prevent deposition

**Other poisons**

1.	Presence of poisonous substances	Change in water quality	Water directly and acutely toxic to some organisms, causing change in community composition; consequential effect on pray- predator relation; sub-lethal effects on some species	Increase dilution
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Inert solids				
1.	Particles in suspension	Increased turbidity. Possibly increased abrasion	Reduced photosynthesis of submerged plant. Impairing feeding ability through reduced vision or interference with collecting mechanism of filter feeders (e.g. reduction in nutritive value of collected material). Possible abrasion	Improve settlement
2.	Deposition of material	Blanketing of substratum, filling of interstices and/or substrate instability	Change in benthic community, reduction in diversity ( increased number of a few species)	Discharge where velocity adequate to ensure dispersion

### RIVER CLEANSING-

Water pollution has increased to such an extent that, rivers are being declared “Dead”. The part of Yamuna River which flows through Delhi is declared as dead as no living organism can sustain in that environment. It is not the case with only river Yamuna but many rivers in India needs quick attention.

India desperately needs strategies to manage its human waste. Out of 22,900MLD of waste-water generated in the country, only about 5,900 MLD (about 26%) is treated before disposal. According to a survey by BORDA, a NGO, out of the 3,119 big and small cities in India, only 217 (about 7%) have centralized sewage treatment plants(STP). A closer analysis reveals that 73% of the STPs operate below their design capacity with 7% of them being defunct. This clearly shows the failure of the centralized treatment plants.

## METHODS-

Waste water should be treated before discharging it into the river

Capacity & quality of sewage treatment plants should be upgraded

Litter traps should be inserted at the mouth of waste water entering into the river so as to stop solid litter/waste entering into the river

NRCA(National river conservation authority) had already started river specific programmes like Ganga actiona plan,etc for the conservation of national rivers.

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