INDIA- LOCATION

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INTRODUCTION

India, also known as Bharat or Hindustan, is one of the world's most culturally and geographically diverse regions. India is home to over 17.5% of the world's population, making it the second most populated nation. However, the nation only makes up 2.42 percent of the global landmass.

GEOGRAPHICAL POSITION

The whole territory that constitutes the nation of India is found on the Indian Plate, which is a component of the more extensive Indo-Australian Plate. The country is located to the north of the equator according to its coordinates, which are 8°4′–37°6′ North and 68°7′–97°25′ East. Its size places it as the sixth largest country on the planet, with a total area of 3,287,263 square kilometres (1,269,219 sq miles).

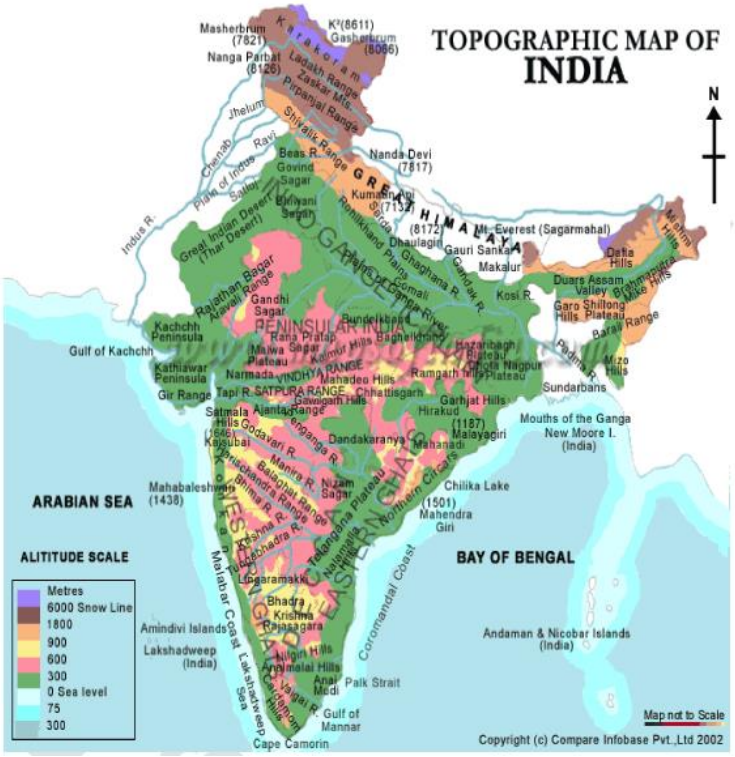
The distance from the country's northernmost point to its southernmost point is 3,214 kilometres (1,997 miles), while the country's breadth is 2,993 kilometres (1,860 miles). It has a land border that is 15,200 kilometres (9,445 miles) long, while its coastline is 7,517 kilometres (4,662 miles) long (4,671 miles). The Arabian Sea can be found to India's southwest, while the Bay of Bengal can be found to its southeast, and the Indian Ocean can be found to India's south. The tip of the Indian peninsula that extends into the Indian Ocean is known as Cape Comorin, which is the most southern point of the peninsula. At a latitude of 6.45 degrees south, Indira Point in the Andaman and

Nicobar Islands is the most southernmost point of India. Sri Lanka is located to the south of India and is separated from India by the Palk Strait and the Gulf of Mannar. Indonesia and the Maldives are other island republics that are located to the south of India. The Indian territorial waters stretch out into the international seas all the way to a distance of 12 nautical miles (13.8 miles; 22.2 kilometres) from the baseline that was constructed for this purpose.

The majority of India's northern border is made up of the Himalayan Mountains, which separate the country from China as well as Bhutan and Nepal. Along its western border with Pakistan is where you'll find the Punjab Plain and the Thar Desert. The watershed region of the Indo-Gangetic Plain, the Khasi hills, and the Mizo hills form India's political border with Bangladesh. The Chin Hills and the Kachin Hills, both of which are thickly forested mountain ranges, separate India from Burma in the far northeast. The Ganges River is the longest river in India and it runs across the Indo-Gangetic Plain as it makes its way south. The Ganges-Brahmaputra system predominates in the northern, central, and eastern parts of India, whereas the Deccan Plateau predominates in the southern parts of the country. Along its western border is where you'll find the Thar Desert, which is the seventh biggest in the world. The highest point in India is K-2, which stands at 8,611 metres (28,251 feet), however it may be found in Gilgit-Baltistan, which is considered to be a part of the contentious region of Kashmir. The summit of Kanchanjunga in Sikkim, which stands at 8,598 metres (28,209 feet) in elevation, is the highest point inside contemporary India. The climate of India is very diverse, with characteristics ranging

from those of the tropics in the southernmost parts of the nation to those of the Alps in the country's highest mountains.

This nation's landmass is bordered by the Arabian Sea to the southwest and the Bay of Bengal to the southeast, both of which are bodies of water that are part of the Bay of Bengal. The countries of Bangladesh and Burma may be found to the east, while Pakistan can be found to the west. Her northern boundary is formed by the countries of Bhutan, Nepal, Tibet, and the province of Sinkiang in China. You'll find the Andaman and Nicobar Islands in the Bay of Bengal, and the Lakshadweep Islands in the Arabian Sea. Both groups of islands are a part of India.



BOUNDARIES

The Arabian Sea is the western boundary, the Bay of Bengal the eastern, and the Indian Ocean the southern boundary of the Indian peninsula. The Maldives are located to the southwest, while Sri Lanka is located to the southeast. “The Himalayas are located in the northern, northeastern, and western parts of the Indian subcontinent. The countries of Bangladesh and Myanmar are to India's east, while to its northwest it shares borders with Afghanistan (106 km) and Pakistan.

The overall length of India's boundaries is 15,106.70 kilometres (9,387 miles). During Partition of India in 1947, the Radcliff Line was drawn to define its boundaries with Pakistan and Bangladesh. It shares a total of 3,323 kilometres (2,065 miles) of land border with Pakistan on its western side. This boundary separates the Punjab area and follows the limits of the Thar Desert and the Rann of Kutchh. India and Pakistan have established a Line of Control (LoC) between their respective portions of Kashmir to function as a de facto border. India asserts that Pakistani-controlled northeastern Kashmir is part of its shared 106-kilometer border with Afghanistan.

There are 4,096.70 kilometres that separate India and Bangladesh from one another (2,546 miles). Along the border between West Bengal and Bangladesh is a thin strip of land known as the Teen Bigha Corridor. Bangladesh has leased this tiny strip of land from India for an unlimited period of time so that it may provide access to its Dehgram and Angalpota enclaves. The Line of Actual Control serves as the de facto border between the People's Republic of China and the Indian subcontinent (LAC). It travels a total of 4,057 kilometres across the Indian subcontinent, passing through the states of Jammu & Kashmir, Uttarakhand, Himachal Pradesh, Sikkim, and Arunachal Pradesh. Both China and India lay claim to the region known as Aksai Chin, which is located in the north-eastern corner of Kashmir. China gained control of this region during the Sino-Indian War in 1962. Up to 1,643 kilometres of the southern borders of India's north eastern states touch the territory of Burma (also known as Myanmar) (1,021 miles). The boundary between India and Bhutan runs for a total of 699

kilometres and runs parallel to the foothills of the Himalayas (434 miles).

Along the foothills of the Himalayas, the 1,751-kilometer-long (1088-mile-long) border that separates Nepal from northern India is located. The Siliguri Corridor is a land route that runs from peninsular India to the northeastern states. It is severely impeded in its movement by the international boundaries of Bhutan, Nepal, and Bangladesh.

GEOLOGY and Evolution of India

Pangaea, the supercontinent, formerly included the Indian craton as a component of its landmass. Its eastern coast was connected to Australia, while its south-western coastline was attached to Madagascar and southern Africa. Pangaea became the supercontinents Gondwana (to the south) and Laurasia (to the north) as a result of rifting that occurred during the Jurassic era (to the north). Even when Gondwana began to fracture in the early Cretaceous, some 125 million years ago, the Indian craton maintained its connection to the supercontinent. After then, the Indian Plate shifted its position, moving farther north and becoming closer to the Eurasian Plate. Around 90 million years ago, scientists believe that the Indian plate separated from Madagascar. The last phases of the Tethys Ocean's drying up may be responsible for this current orogeny, which may be traced back to those periods. The Himalayas and the Tibetan Plateau both originated as a result of the drying up of seas that were also responsible for the formation of the Alps in Europe and the Caucasus in western Asia. A portion of Asia on each side of the ongoing orogenic event is undergoing deformation toward the west and the east. As a consequence of this collision, the Australian Plate and the Indian Plate, which were located

nearby, got sutured together to form what is now known as the Indo-Australian Plate.

Evolution of India

As the top crust of the earth cooled and solidified, gneisses and granites were revealed, mainly on the Peninsula. This event, which occurred during the Archaean era, marked the beginning of the earliest period in the history of tectonic activity (before to 2.5 billion years ago). The bedrock that supports the Indian craton is made up of these. The Aravalli Range is all that is left over from an orogeny that occurred during the early Proterozoic and was responsible for connecting the two previous sections that make up the Indian craton. The Aravalli-Delhi orogeny is the name given to this particular orogeny. It begins in the far north and continues southward, finally reaching the lonesome hills and steep peaks of Haryana before coming to a conclusion close to Delhi. Deformation (folding and faulting), together with certain small igneous intrusions and metamorphism, contributed to the forming of the Aravalli Mountains.

As the mountain continues to erode, the second stage of the process involves sediments from the Dharwarian group becoming increasingly distorted. Due to the characteristics of these sediments, evidence of the volcanic activities and intrusions that took place during this second epoch has been preserved. The early and late Proterozoic periods, which

coincided with wet and semi-arid climatic regimes, respectively, saw the deposition of calcareous andarenaceous deposits in both the Cuddapah and Vindhyan basins.

The earth was pushed up during the Cambrian Period, revealing these basins that are either next to or confined inside the underlying crystalline foundation (500 Ma). It is believed that the Vindhyans were deposited between 1700 and 650 million years ago.

The Himalayas are made up of sediments that were deposited on the Indian platform in the early Palaeozoic epoch. These sediments were eroded from the crystalline craton in the south and then deposited there. The activity of sag and normal faulting throughout the Late Paleozoic resulted in the formation of new basins across the central region of India. These glaciations resulted in the deposition of huge glacio-fluvial deposits. Glacial processes led to the deposition of sediments like tillites, which are referred to collectively as the Gondwanaseries. Permian marine invasion sediments are overlain by rocks made of igneous material (270 Ma)

During the same time period in the late Paleozoic, the Gondwana supercontinent underwent deformation and moved over the Earth's surface.

Both the elevation of the Vindhyan layers and the deposition of sediments from the northern edge in the Himalayan Sea may be attributed to this drift. During the Jurassic period, when Pangaea was beginning to split apart, enormous grabens formed in the central region of India. These grabens were later stuffed with sandstones and conglomerates that dated back to the Upper Jurassic and Lower Cretaceous periods.

By the time the Cretaceous era came to a conclusion, India had severed its ties to both Australia and Africa and was making its way steadily into Asia's northernmost regions. Prior to the Deccan eruptions, the uplift that occurred in southern India caused sedimentation to form in the adjacent forming Indian Ocean. Both Pondicherry and Tamil Nadu, which are both located in southern India, are home to these rocks.

The Deccan lava flows were one of the greatest volcanic eruptions to ever occur on Earth, and they occurred just as the Mesozoic period was coming to a close. These, which have a total area of around 500,000 square kilometres, demarcate the decisive break away from Gondwana. The Karakoram orogeny was the first stage of the Himalayan orogeny and it started in the early Tertiary. The orogenetic activity in the Himalayas has not slowed down at all.

PHYSIOGRAPHIC DIVISION

The four major geographical regions of India are:

1. The Great Himalayan range,
2. The Indo Gangetic Plain,
3. The Deccan Plateau and Peninsula
4. The Coastal plains
5. The Islands

HIMALAYAN MOUNTAIN SYSTEM

This is the enormous physiographic unit that resembles a wall and it stretches from the most northwestern part of Kashmir all the way to the Indian border in the east. This region is made up of the eastern highlands, which include mountain ranges like as

the Karakoram, Ladakh, and Zaskar ranges, as well as the Himalayas.

There are three separate mountain ranges that come together to form the Himalayas. These ranges are known as the Trans Himalayas, the Himalayas, and the Eastern Himalayas. The Pamir Knot may be found in the Karakoram, Ladakh, and Zaskar mountain ranges, all of which are included in the Trans Himalayas.

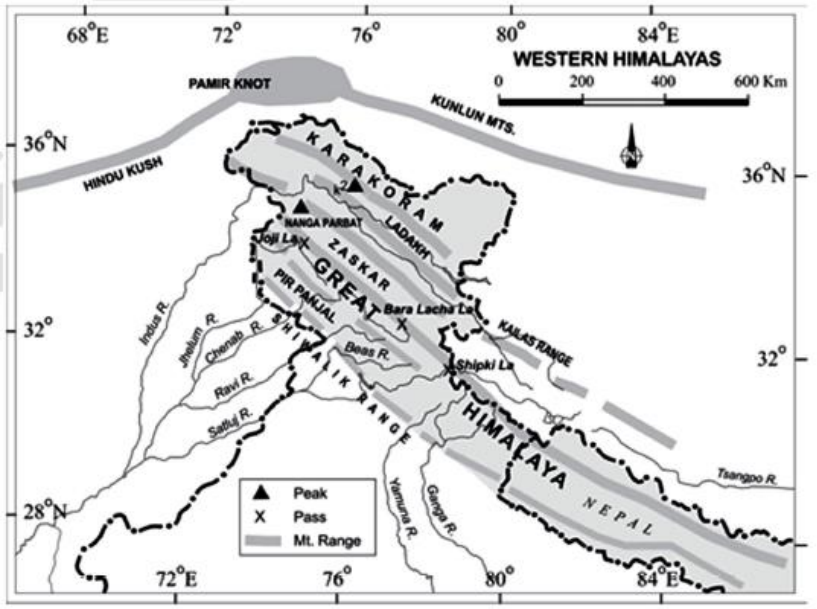
Mount Godwin Austin, which stands at 8611 metres, is India's highest peak. It is also often referred to as Mount K2.

There are three different ways that the Himalayas may be categorised: I as the Himalayan ranges, (ii) as the Trans-Himalayas, or (iii) as the Eastern Hills.

When travelling eastward through the mountainous regions of the Northern United States, one will note that the height of the mountain ranges gradually decreases. The Eastern highlands cover a region with an elevation ranging from 500 to 3000 metres above mean sea level (Purvanchal).

Some Basic Facts :

1. **Duns:** Between the Lesser Himalaya and the Shivalik Mountains is a lengthy valley called the duns.



2. The Himalayas are sometimes referred to by the names Himaven and Himachal.

3. The tertiary mountain ranges that make up this region are the world's youngest and highest.

4. It is young, has a tectonic origin with extensive bending and deformation, and is heavily eroded by rivers.

5. Nearly 22 degrees of longitude separate the western Indus Gorge from the eastern Brahmaputra Gorge (Dihang Gorge), a distance of over 2400 kilometres.

6. From west to east, the Himalayas shrink from a maximum of 500 kilometres at Kashmir to a minimum of 200 kilometres at Arunachal Pradesh.

7. It's an arcate form that stretches from west to east and is convex to the south.

Origin of Himalayas

The most current and commonly accepted explanation for the Himalayas' genesis is plate tectonics. A plate is a large, mobile chunk of lithosphere that floats on the asthenosphere below. Convergence occurs when two plates come closer together and one plate eventually rides up and over the other. The overthrown plate is sucked down into the Earth's mantle, where it is either lost forever or digested by the biosphere. The Himalayas and other folded mountains rise along the border where two tectonic plates converge. The denser plate is subducted beneath the lighter plate during a collision between two convergent plates made of continental crusts. Sediments deposited on either side of the continental plate borders experience lateral compression as a consequence, squeezing and folding them. The Himalayas formed as a result of such a process in the transport zone between the Asian and Indian plates. The Tethys Sea began to narrow some 70 million years ago when the Indian plate began sliding toward the Asian plate. The sediment underwent three distinct periods of folding, giving birth to the three Himalayan ranges described below.

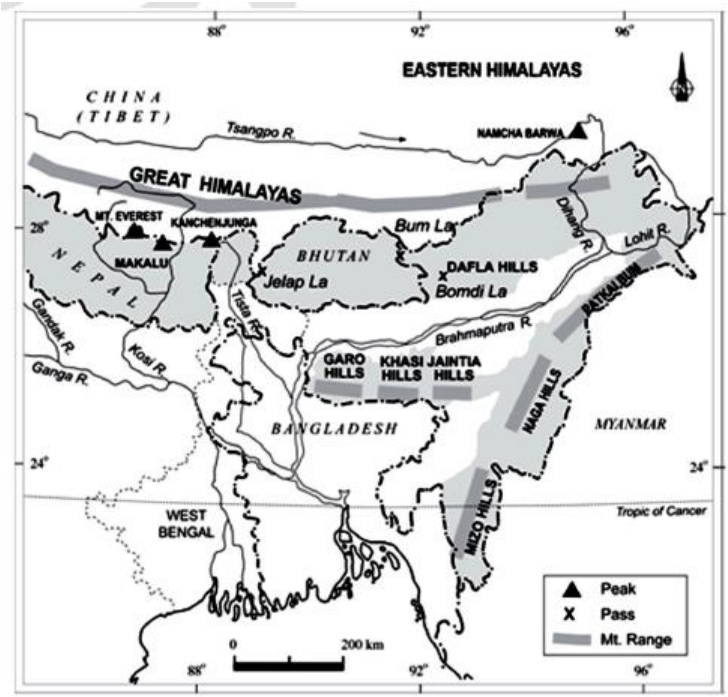
Cross-Sectional view of Himalayas

1. The Great Himalaya: This region is sometimes referred to as the Himadri or the central Himalaya.

It consists mostly of metamorphosed sedimentary races that lie on top of a core of crystalline material (granites and gneisses). It's the longest, unbroken chain of mountains, and its summits are on average over 6,000 metres high. Archaean rocks including granite, gneisses, and schists make up the bulk of these mountains. This range's folds are uneven, having a more severe

south face and a more mild north face. From the north-west corner at Nanga Parbat to the north-east corner at Namcha Barwa, which is convex to the south, it stretches in an arcate form. The average height is 6100 inches and the breadth is 25 kilometres.

2. The Middle or the Lesser Himalaya: Lower Himalaya is another name for this region. Metamorphic rocks and nonfossiliferous sedimentary rocks make up the bulk of its make-up. The northern slopes are densely wooded whereas the southern ones are barren and rocky. Important mountain ranges include thePir Panjal, Dhauladhar, Musoorie range, Nag Tibba, and Mahabharata. Kashmir's Pir Panjal is the longest and most significant range in the world. The national route from Jammu to Srinagar crosses the Banihal pass in the Pir Panjal range. Kashmir is located between two mountain ranges, the Zaskarrange and the Pir Panjal. This area is where you'll find the majority of India's hill stations, such as Shimla, Mussoorie, Ranikhet, Nainital, Nainital, Almora, Darjeeling, etc. The usual width is 60-80 km, and the average height is 3,500-5,000 m.



Mountain Peaks in the Himalaya	
Mt Everest	8848 M
Mt K2	8611 M
Kanchanjunga	8598 M
Makalu	8481 M
Dhaulagiri	8172 M
Annapurna	8078 M

3. The Shiwaliks or the Outer Himalaya: There are low mountains stretching from the Potwar plateau to the Brahmaputra river. Sand, clay, rounded stones, gravels, slates,

etc. are all examples of river deposits that may be found in these mountain ranges. The poor drainage in this area is especially noticeable in the Terai. It is heavily wooded in the east, up to Nepal, but the forest gradually thins out in the west. Height is often between 1000 and 1500m, while breadth is typically between 15 and 50 km. Tista and raidak gorges have joined together to create a cleft 80-90 km wide in the Shiwalik mountains. The Shiwalik have several names depending on where you are. Arunachal Pradesh's are known as the Dafla, Miri, Abor, and Mishmi Hills, whereas Jammu's are named the Jammu Hills.

Regional Division of Himalayas

On the basis of river valleys Himalayas can be longitudinally divided into the following
sections:

(I) Kashmir Himalaya

1. Average elevation is about 3000m.
2. This section has the largest share of shows and glaciers
3. **Two important passes**: Pir Panjal and Banihal - lie in Pir Panjal range.
4. The Valley of Kashmir lies in this section.

(II) Punjab Himalaya

1. Stretches eastward uptoSatluj for about 570km.
2. High Peaks are rare.
3. **Main ranges:** Karakoram, Ladakh, Pir Panjal, Zaskar and Dhauladhar
4. **Important Passes:** Zojila, Rohtang and Bara Lacha la.
5. **Important Valleys:** Kangra, Lahul and Spiti.
6. This section is important for fruit cultivation (horticulture) and scenic beauty.

(III) Kumaon Himalaya

1. Stretches from Satluj to Kali River for about 320km and the general elevationis higher than Punjab Himalayas.
2. Its western part is called Garhwal Himalaya while eastern part is known asKumaon Himalaya proper.
3. **Important peaks:** Nanda Devi, Kamet, Trishul, Badrinath, and Kedarnath
4. Nanda Devi is the highest peak in this section.
5. **Important lakes:** Nainital and Bhimtal
6. Several duns lie between Middle Himalayas and Shiwaliks.

(IV) Central Himalaya

1. Extends from river Kali to Tista for about 800km.
2. Most of it lies in Nepal and hence it is also called as Nepal Himalaya.
3. This section has some of the world's highest peaks, such as, Mt. Everest,Makalu, Kanchanjunga, Dhaulagiri, Annapurna, and Gosainthan.
4. This section is known as Sikkim Himalaya in Sikkim, Darjeeling Himalaya in WestBengal and Bhutan Himalaya in Bhutan.
5. Bilafond la also known as pass of the butterflies.
6. Saltoro pass is a mountain pass situated in Saltoro ridge on the west of Siachen glacier.
7. Chang la is the main gateway for the chang tang plateau, situated in theHimalayas.
8. The Debsa pass provides an easier and shorter alternative to the traditional Pin-Parbati pass route between Kullu and Spiti.

(V) Assam Himalaya

1. Stretches from river Tista to Brahmaputra for about 720km.
2. Pauhunri and Kulakangri are important peaks.

3. The Naga hills and Patkai Bum hills of this section form the watershed betweenIndia and Myanmar.

(VI) Trans Himalayas

1. It immediately lies north of the Great Himalayan range.
2. It is also called the Tibetan Himalaya because most of it lies in Tibet.
3. The Zaskar, the Ladakh, the Kailash and the Karakoram are the main ranges ofthis system.
4. Mt. K-2(Godwin Austin), Nanga Parbat, Rakaposhi, Haramosh, Gasherbrum-I(Hidden Peak), Gasherbrum-II etc. are important peaks.
5. This section has some of the world's largest glaciers - Siachen, Hispar, Biafo,Batura and Baltoro.
6. Ladakh Plateau (5000m), the highest plateau of the Indian Union, lies to the north-east ofthe Karakoram range. It has been dissected into a number of plains and mountains. The mostoutstanding among them are Aksai Chin, Soda Plains, Lingzi Tang, Depsang Plains,and Chang Chenmo.

(VII) Eastern Hills or the Purvanchal Hills

The Himalayas make a sharp bend south after passing through the Dihang canyon (Brahmaputra gorge), taking the appearance of a crescent with its convex side facing west. As a group, these mountains in the east of the nation are known as the Purvanchal. It forms the border between India and Myanmar and stretches from Arunachal Pradesh in the north to Mizoram in the south. Part of the Arakan Yoma Suture zone, which also includes the Andaman and Nicobar island chain and ends in Sunda, is the Indo-Burma mountain range. Rough terrain, thick woods, and fast streams are hallmarks of the Eastern Hills (Purvanchal), whose height drops from north to south. All these Ranges are

fewer than 2,000 metres in altitude, yet they are rather intimidating due to their thick woods, extremely rough terrace, and unfriendly tribe.

It comprises of the following hills -

a) **Mishmi hills:** Includes the Purvanchal's highest peaks. Its highest point is Dapha Bum.

b) **Patkai Bum Range:** The Tipam sandstone- and synclinal-structured Northern Range marks the easternmost edge of the Great Himalaya Mountains.

c) **Naga Hills:** Its highest peak is Saramati (at 3826m), and it is located to the south of the Patkai Bum. The watershed between India and Myanmar is formed by the Patkai Bum and Naga hills.

d) **Manipur Hills:** The Naga Hills, located to the south, mark the border between Manipur and Myanmar. At its heart lies a massive basin that might once have been the lake bed of Loktak Lake, a fragment of which currently occupies the basin's south-east corner. The Barail Mountains divide the Naga Hills from the Manipur Hills.

e) **Mizo Hills (Lushai Hills):** Its highest peak, Blue Mountain, is 2,157 metres above sea level and is located to the south of the Manipur highlands.

Significance Of The Himalayas

The Himalayas are India's most notable physical feature. The Himalayas have had a greater impact on the lives of people and the course of a nation's history than any other mountain range on Earth. The Himalayas represent India's very heart and soul. The Himalayas are a unique part of India's national mountain system. The Himalayas are very important to India, and I'll explain why in just a few words.

1. Climatic Influence. The Himalayas have a huge impact on India's weather patterns. The summer monsoons from the Bay of Bengal and the Arabian Sea are efficiently intercepted and turned into rain or snow due to their high height, length, and direction. In addition, they block the cold continental air masses from central Asia from reaching India. Without the Himalayas, the whole subcontinent of India would be a desert, and the harsh winters brought on by air from Central Asia would last all year long. Recent meteorological research indicates that the Himalayas are crucial in bringing about the Indian monsoons because they act as a divider between the jet stream and another wind current.

2. Defence. The Himalayas have served as a defensive barrier for India since the beginning of recorded history. However, the Himalayas' defensive importance was greatly diminished by China's invasion of India in October 1962. The Himalayas remain strategically important for defence, even as modern weapons have greatly improved in their effectiveness.

3. Source of Rivers. Almost all of India's major rivers begin high in the Himalayas. The powerful rivers of India are fed by the country's plentiful precipitation, which in turn comes from the country's extensive snowfields and massive glaciers. These rivers are perennial because they get water from snowmelt even in the dry season. All of north India depends on the Himalayan Rivers and the hundreds of rivers that flow from them.

4. Fertile Soil. While flowing down from the Himalayas, the major rivers and their tributaries transport massive amounts of alluvium. The Great Plain of Northern India benefits from this by receiving rich soil deposits. Consequently, the plain is among the world's most productive agricultural regions. The

Brahmaputra carries even more silt than the Ganges and the Indus do, with an estimated 19 and 10 lakh tonnes per day, respectively. That's why the Himalayas are generally credited with gifting India's immense plain to the country.

5. Hydroelectricity. The Himalayan region offers several sites which can be used for producing hydroelectricity. There are natural waterfalls at certain places while dams can be constructed across rivers at some other places. The vast power potential of the Himalayan Rivers still awaits proper utilization.

6. Forest Wealth. The Himalayan ranges are very rich in forest resources. In their altitude, the Himalayan ranges show a succession of vegetal cover from the tropical to the Alpine. The Himalayan forests provide fuel wood and a large variety of raw materials for forest based industries. Besides many medicinal plants grow in the Himalayan region. Several patches are covered with grass offering rich pastures for grazing animals.

7. Agriculture. While the Himalayas don't have many flat areas, some of the slopes have been terraced for farming. The terraced slopes mostly grow rice. Wheat, maize, potatoes, tobacco, and ginger are the other major crops. As a special crop, tea can only be cultivated on the sloping terrain of hills. Apples, pears, grapes, mulberries, walnuts, cherries, peaches, apricots, etc. are just few of the many fruit varieties that may be found in the Himalayas.

8. T**ourism.** The Himalayan mountains have become home to several tourist destinations because to their stunning natural beauty and pleasant climate. When the surrounding plains are sweltering in the summer heat, those who live in the Himalayan mountains' steep regions may enjoy a cool and pleasant atmosphere. Every year, millions of people from all over the

world, as well as all over the nation, go to the Himalayas to experience the region's breathtaking scenery and cool down from the sweltering summer heat. The influx of visitors in the winter months may be attributed to the growing appeal of snowy weather and winter activities. Important tourist centres in the Himalayas include Srinagar, Dalhousie, Dharmashala, Chamba, Shimla, Kulu, Manali, Mussoorie, Nainital, Ranikhet, Almora, Darjeeling, Mirik, Gangtok, etc.

9. Pilgrimage. The Himalayas are proud to host several sacred sites, which are believed to be the dwelling places of many deities, in addition to the many tourist attractions found there. Large numbers of worshippers make the hazardous journey to these holy sites. There are several holy sites in India, including Kailas, Amarnath, Badrinath, Kedarnath, Vaishnu Devi, Jwalaji, Uttrkasi, Gangotri, Yamunotri, etc.

10. **Minerals.** Many rare and precious minerals may be found in the Himalayas. Mineral oil in the tertiary ridges has enormous potential. Kashmir is a coal producer. More than a hundred sites in the Himalayas have been confirmed to contain copper, lead, zinc, nickel, cobalt, antimony, tungsten, gold, silver, limestone, semi-precious and precious stones, gypsum, or magnetite.

Unfortunately, at the current state of technology, most of the mineral resources cannot be mined because of unfavourable geographical circumstances. The potential of mineral extraction continues to grow as new technologies become available for extracting these materials.

exploitation in the Himalayas are great.

The highest mountain range of the Himalayas. These ranges have an average height of about 6000 m. Highest Mountain peaks are situated in this range. (e.g.Kanchanjunga - 8595m, Nangaparbat- 8126m) The source of Ganges and Yamuna	Situated to the south of the Himadri. Average height is above 3000 m Many health resorts are situated on the southern slope of the mountain range, e.g.: Shimla, Darjeeling	This is the outer most range to the south of the Lesser Himalayas. These discontinuous ranges join the lesser Himalayas in the extreme east. Its average height is about 1200m There are several elongated and flat valleys running parallel to the mountain ranges. They are called duns. (e.g.: Dehradun)

THE NORTHERN PLAINS

It reaches from the Ganges delta in the east, over the dry and semi-arid plains of Rajasthan in the west, and the Himalayas in the north. There are three important river systems that drain the area: the Ganga, the Indus, and the Brahmaputra. Alluvial deposits transported by both the Himalayan rivers and the Peninsular rivers are thought to have filled in a maritime depression or fore deep, which developed owing to Himalayan uplift and subsidence of the northern blank of the plateau, to create the plain.

Origin of the plain

The sediments carried by the rivers that flow from the Peninsula and the area around the Himalayas were deposited in a deep depression between those two locations, which resulted in the formation of the enormous plain that we can see today. This theory is almost universally accepted. On the other hand, there has been some discussion as to whether or not the region that is located between the Peninsula and the Alps was previously home to a deep depression or furrow. Edward Suess, an eminent Austrian geologist, postulated that a foredeep was formed in front of the towering crust waves of the Himalayas when they were halted in their southerly progress by the indestructible solid landmass of the Peninsula. Suess's hypothesis is based on the observation that the Peninsula is an indestructible solid landmass. This frontal depression had the appearance of a massive syncline, into which rivers from both the Himalayas and the Peninsula had deposited their alluvium. The Great Plain of

North India was formed as a result of the gradual accumulation of alluvium throughout time. The crystalline rocks that connect the Himalayan and Peninsular mass tectonic plates provide support for this region. On the other hand, Sir Sydney Burrard is of the opinion that the Indo-Gangetic alluvium is covering over a massive crack or fissure in the sub-crust of the earth, with the resulting depression being filled up by detrital over the course of time. He attributed the elevation of the Himalayan range to a tangential bending or curbing movement of the northern wall of the fissure, and thus to the sub-crustal fractures or rifts, which he considers to be of essential significance in geotectonics. He also attributed the elevation of the Himalayan range to a tangential bending or curbing movement of the southern wall of the fissure. Rift Valleys are low-lying areas that may be found in between parallel and vertical cracks. This plain was formed by a rift valley that was around 2,400 kilometres long and hundreds of metres deep. This rift valley is located between the Himalayan hills and the Peninsula. His findings are based on certain abnormalities in the measurements of plumb line deflections and other geodetic elements. His conclusions are based on these findings.

Other rift valleys in the Himalayas, as well as the Narmada and Tapi in Peninsular India, were also brought up in the discussion. The explanation of the Indo-Gangetic depression offered by Burrard has been challenged by researchers such as Hayden and R.D. Oldham, in addition to other geologists from the Geological Survey of India". The fact that Burrard's idea is not supported by any evidence of a rift valley on the northern side of the peninsula is the most important argument against it. There is a widespread consensus among geologists and cartographers

that the Peninsula's movement to the north led the silt that was deposited on the bed of the Tethys Sea to become curved and deformed. This mechanism is responsible for the formation of the Himalayas as well as a trough in the southern hemisphere. The valley or dip that may be found at the foot of the mountain must have some kind of relationship to the mountain itself. The Peninsular Block and the Himalayas are responsible for the advancement of the Great Plains because they are filling in the foredeep as they move forward. During the time period in which there was a significant amount of gradational activity, the infilling was accomplished by the deposition of the debris that was carried from the mountains by the many rivers that emerged from them. The geological strata that make up the bulk of this plain date to the Pleistocene and Recent epochs.

Characteristic &Geo-Morphological Features

From North to South

1. **Bhabar:** The sediments carried by the rivers that flow from the Peninsula and the area around the Himalayas were deposited in a deep depression between those two locations, which resulted in the formation of the enormous plain that we can see today. This theory is almost universally accepted. On the other hand, there has been some discussion as to whether or not the region that is located between the Peninsula and the Alps was previously home to a deep depression or furrow. Edward Suess, a prominent Austrian geologist, postulated that a foredeep was formed in front of the towering crust waves of the Himalayas when they were halted in their southerly progress by the indestructible solid landmass of the Peninsula. This was Edward Suess's contribution to the field of geomorphology. This frontal depression had the appearance of a massive syncline, into which

rivers from both the Himalayas and the Peninsula had deposited their alluvium. The Great Plain of North India was formed as a result of the gradual accumulation of alluvium throughout time. The crystalline rocks that connect the Himalayan and Peninsular mass tectonic plates provide support for this region. On the other hand, Sir Sydney Burrard is of the opinion that the Indo-Gangetic alluvium is covering over a massive crack or fissure in the sub-crust of the earth, with the resulting depression being filled up by detrital over the course of time. He attributed the elevation of the Himalayan range to a tangential bending or curbing movement of the northern wall of the fissure, and thus to the sub-crustal fractures or rifts, which he considers to be of essential significance in geotectonics. He also attributed the elevation of the Himalayan range to a tangential bending or curbing movement of the southern wall of the fissure. Rift Valleys are low-lying areas that may be found in between parallel and vertical cracks. The rift valley that exists between the Himalayan peaks and the Peninsula is responsible for the formation of this plain. It is about 2,400 kilometres long and hundreds of metres deep. His findings are based on certain abnormalities in the measurements of plumb line deflections and other geodetic elements. His conclusions are based on these findings.

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2. **Tarai**: Streams dry up in Bhabarbelt but make a comeback in the Terai. There is a vast range of flora and fauna in this 10–20 km wide, poorly drained, swampy, densely wooded region. Most of the Terai has been reclaimed and transformed into agricultural land, particularly in Punjab, Uttar Pradesh, and Uttaranchal, and it now produces plentiful sugarcane, rice, and wheat. This area is home to Dudhwa National Park.

3. **Bhangar (Bengha):** Above the level of the flood plains, it forms a terrace made of ancient alluvium. Kankar, or calcareous concretions, are often found imbedded in these terraces.

4. **Khadar:** The flood plains along riverbanks are made up of alluvium that has formed more recently and are vulnerable to flooding during the wetter months.

5. **Reh or Kallar:** It consists of dry, arid regions of Uttar Pradesh and Haryana, characterised by barren salineefflorescences.

6. **Bhur:** It represents Pleistocene aeolian deposits in the middle Ganga–Yamuna Doab.

Region-wise Division

a) **Western Plains:** The dry districts of Rajasthan, the Rann of Kuchchh, and the drier portions of Punjab and Haryana are all covered by these flatlands. In these locations, wind is more powerful than water. This area was submerged in water from the Permo-Carboniferous all the way through the Pleistocene epoch. A small few of the salt lakes that can be found there are Sambhar, Didwana, Degana, Pachpadra, and Kuchaman, among others. The Dhrian, also known as the varied sandiness, the Raun, also known as the Playa Lakes, and the Rohi are all significant geomorphological elements of this plain (fertile lowlands west of the Aravallis).

b) **Punjab - Haryana Plain:** Five major rivers drain this flat area. The most notable aspects of this region are the rivers Jhelum, Chenab, Ravi, Beas, and Satluj, as well as the Panjdoabs (Doabs – the land between two rivers).

(a) **Bist:** (Jalandhar Doab) between Beasand Satluj

(b) **Bari** -between Beas and Ravi

(c) **Rachna** - between Ravi and Chenab

(d) **Chaj**-between Chenab and Jhelum

(e) **Sind Sagar** - where the Indus meets the Jhelum Only the Ghaggar, sometimes called the modern-day successor of the mythological Saraswati River, flows between the Yamuna and the Satluj. Bets refers to the flood-prone yet agriculturally significant Khadar area. Khadar belts are framed by steep,

gullied cliffs called Dhayas in the area. Numerous streams known as Chos have done extensive erosional work on the northern section of this plain next to the Shiwaliks.

c) **Ganga Plain:** Including the states of Uttar Pradesh, Bihar, and West Bengal, this is the greatest section of the Great Plain of India that stretches from Delhi to Kolkata. The whole plain generally slopes to the east and south. There are clear cultural and physical divides in these plains.

• **Ganga - Yamuna Doab:** There isn't a bigger doab between the Ganges and the Yamuna. The badland landscape is the result of the fragmentation of the Bhangar uplands along the Yamuna and Chambal streams into a complex network of ravines and gullies. The Bhabar plains, Terai, Bhangar, and Khadar are just a few of the region's most distinctive characteristics. Khotsare the mountain ridges that separate Bhangar from Khadar. The upper doab also has a peculiar geological feature called Bhur, which was created by Pleistocene aeolian deposits.

• **Rohilkhand Plains:** It reaches from the Himalayan foothills to the Ganges to the east of the Ganga-Yamuna doab. Located wholly inside Uttar Pradesh, it is serviced by the rivers Ramganga, Gomati, and Sarda. North of the equator, the Bhabar and Terai plains have flourished. The predominant direction of the slope is south-east.

• **Awadh Plains:** This physiographic area includes the vast majority of the gently sloping lowland north of the Ganga. Khadar and Bhangar strips are especially noticeable in this part, while the Ghaghra is the master -stream that runs the length of the Awadh plains.

• **Bihar Plains:** The Bihar Plains are the next section of the Great Plains after the Awadh Plains in Uttar Pradesh finish; they are

constricted to the east by the extension of the Rajmahal Hills. It may be further separated into two components, one based on Relief, and the other on river conditions.

North Bihar Plain - It is situated to the north of the Ganges and is drained by tributaries of that river. It has slopes that face south-east in the west and south in the east. CHAURS is the name that the locals give to the extensive stretch of marsh that is located along the Ganga. One of the few valleys that is sufficiently deep to have water present throughout the year is the Kabar Tal.

South Bihar Plain - The enormous depressions of Jala near Patna and Tal near Mokama are located to the west of the Rajmahal Hills and to the east of the southern bank of the Ganges.

• **North Bengal Plains:** Its eastern section is drained by the rivers entering the Brahmaputra and its western part by the tributaries of the Ganga, and it stretches from the foot of the Eastern Himalaya to the northern boundary of the Bengal basin. The waters of the Tista, Jaldhaka, and Torsa rivers drain it. The western Dhar, on its northern edge, is a flat, well-drained area perfect for tea farms. The ancient Ganga delta, built during the Pleistocene epoch and subsequently up-warped and eroded into terraces, may be found to the south of Dhars in the Bhangar area of the Barind plain.

• **Bengal Basin:** It includes much of the alluvial plains of East Pakistan and West Bengal. The delta of the Ganges River takes up most of the space in the Bengal Basin. In the south, you'll find the densely wooded Sunderbans, while in the north you'll find the lifeless and dying rivers of the Bhagirathi plains.

• **Rarh Plain:** Although it is not technically a part of the delta, the lowlands to the west of the Bhagirathi River are just as flat. Among the region's other distinctive features are the Damodar River's natural levees. Lateritic silks are the product of extensive weathering. It is said that the Damodar River is the grief of Bengal because of the havoc it causes.

PENINSULAR PLATEAU REGION

The southernmost point is indicated by Kanyakumari, which is also the northernmost point of the island, which corresponds with the southern end of the vast plain. Its western and eastern bounds are defined by the Western Ghats (Sahyadris) and the Eastern Ghats, respectively. To the north, it is bordered by the Aravali range, the Vindhyas, the Satpura, the Bharmer, and the Rajmahal hills.

Approximately half of all of India's landmass is contained inside its boundaries, making up India's ographic unit. The Narmada-Tapi rift is the only part of the plateau that slopes in the opposite direction, whereas the rest of the plateau normally descends from west to east.

Key hill and plateau ranges on the peninsula are as follows:

1. **Aravali range -** stretches over 800 kilometres between Delhi and Ahmedabad, from north-east to south-west. As a result of folding during the Archaean period, this mountain is among the oldest in the world. Mt. Abu (1,158 m) is within this broad elevation range of 400 to 800 m. Mt. Abu is home to the tallest summit, Guru Shikhar (1722m).

2. **Marwar Upland -** It's in eastern Rajasthan, to the east of the Aravali Range (or upland). The sedimentary rocks that make up this area date back to the Vindhyan epoch. Specifically, the

Banas River is responsible for carrying all of the water away from here.

3. **The Central Highland -** positioned east of the Marwar highland; also known as Madhya BharatPathar. The northern portion, known as the Chambal river gorges or Badlands, is heavily wooded.

4. **Bundelkhand Upland -** Its location in between the Yamuna and the Vindhyan range is very strategic. Only granite, or Bundelkhand Gneiss in Indian geology, was used to chisel it.

5. **Malwa Plateau -** Located in the state of M.P., to the north of the Vindhyanrange, this area is mostly made up of lava flow and is coated with dark soils. The Chambal, Parbati, Sindh, Kali, Betwa, and Mahi rivers all flow into it.

6. **Baghelkhand-** It is located to the east of the Maikal Range and is made up of granite in the east and limestone and sandstone in the west of the mountain range. The geographical centre of the plateau acts as a watershed dividing line between the Son drainage system in the north and the Mahanadi river system in the south of the plateau. The scarps of Vindhyan sandstone that can be seen between the Ganga plain and the Narmada-Son trough are the most important physiographic feature that can be found here.

7. **Chotanagpur Plateau -** Into the state of Baghelkhand, the Indian Peninsula continues to stretch to the north-east, where it can be found extending beyond Jharkhand, the northern section of Chhattisgarh, and the Purulia district of West Bengal. This can be found beyond the state of Baghelkhand. Gondwana Rocks make up the majority of the terrain, with pockets of Archaean granite and gneiss as well as Deccan Lava Fields thrown in for good measure. The Pat lands, which are a high-

level laterite plateau, include the highest points in the area. In the middle of this region, in a rift valley that runs from west to east, you'll find the Damodar River. Along its banks, you'll discover the Gondwana coal riches.

a) **Hazaribagh Plateau -** An average-elevation peneplain of 600 metres north of the Damodar River. The tallest peak is called Parasnath (1,366 m). Granites and gneisses are the main components.

b) **Ranchi Plateau -** South of the city of Damodar. The average altitude is about 600 metres. Gorurise (1142m) and Netarhat Pat (1119m) are the two tallest peaks in Pats.

c) **Rajmahal Hills -** North and northeastern Chhotanagpur plateau cliffs are formed by basalt and lava flows.

8. **Meghalaya Plateau (Shillong Plateau) –**It is an extension of the peninsular plateau to the north-east, with the Garo Rajmahal Gap separating it from the mainblock. Quartzites, shales, and schists developed throughout the Archaean period, with granite forming intersections. Important hills may be found in the west (Garo, 900 m), the centre (Khasi - Jaintia, 1500 m), and the east (Mikir, 700 m) of the plateau. The peak elevation is at Shillong (1961m).

9. **Deccan Plateau -** The Vindhyas, Satpura, Mahadev, and Maikal ranges to the north; the Western Ghats to the west; and the Eastern Ghats to the east form the northern boundary of this triangle plateau, the biggest unit of the peninsularplateau at 5 lakh sq. km. The overall slope runs from west to east, and the average altitude is about 600 metres (higher in the south than the north). There are points of division.

a) **Maharashtra Plateau:** Most of the area is made up of basaltic rocks that originated from lava and have been weathered

to seem like a rolling plain. The classic Deccan Trap was created by the horizontal lava flows. The ground there is made up of the dark cottony Regur dirt.

b) **Karnataka Plateau (Mysore Plateau)** -Consisting mostly of Archaean igneous rock. Mulangiri (1918 m) in the Baba budan hills is the highest point. Split in two halves -

i) **Malnad -** hilly region with denseforest.

ii) **Maidan -** rolling plain with low granitehills.

iii) **Telangana Plateau** - In AndhraPradesh consists of ArchaeanGneisses, drained by Godavari,Krishna and Penneru.

10. **Chhattisgarh Plain -** The upper basin of the Mahanadi River drains this saucer-shaped valley that sits between the Maikal Range and the Orissa Hills. Cuddapah-age limestone and shale strata lay almost horizontally over the basin floor.

11. **Vindhyan Range -** It is an escarpment that flanks the northern side of the Narmada -Son Trough and serves as a watershed between the Ganga system and the riversystems of south India. Sedimentary rocks make up the bulk of the area. Lava flows over the western side.

12. **Satpura Range -** Between the rivers Narmada and Tapi, there is a chain of seven mountains that may be broken down into three sections:

a) **Western part** - Located in the area, these basalt hills are called Rajpiplahills.

b) **Central part -** bounded by the Mahadev Hills to the north and the Gawligarh Hills to the south. Pachmarhi hill station's closest major peak is Dhaupgarh.

c) **Eastern part -** is Maikal Plateau.

Eastern Ghats

The Eastern Ghats are lower in elevation than the Western Ghats. They typically top out at about 450 metres and seldom go beyond 1200. The low Sirumalai and Karanthamalai hills in southern Tamil Nadu form the southernmost section of the Eastern Ghats. Kollimalai, Pachaimalai, Shevroy (Servaroyan), Kalrayan Hills, Chitteri, Palamalai, and Mettur hills are among the taller mountains to the north of the Kaveri River. It is often colder and wetter in the higher hill ranges than in the lowlands. Many coffee farms and arid woodlands may be found in these slopes.

Yercaud, a popular hill station, may be found in the Shevroy Hills. The Nilgiri Hills form a forested biological corridor between the Eastern and Western Ghats, stretching east from the Western Ghats to the Kaveri River. There is the second-largest number of wild elephants in India here.

Two rivers, the Ponnaiyar and the Palar, find their way through rifts in the Ghats and eventually empty into the Bay of Bengal. The Javadi Mountains act as a natural barrier between these two waterways. There are waterfalls in some remote regions. One of them is the Kiliyur Falls. The centre part of the Eastern Ghats, in Andhra Pradesh, consists of two parallel ranges running roughly north-south: the lower Velikonda range is located to the east, while the higher Palikonda-Lankamalla-Nallamalla ranges are located to the west. The Nallamalla Range extends to the Krishna River, while the Velikonda Range drops to the coastal plains in the northern Nellore district.

The Krishna and Godavari rivers are separated by a series of low hills, while Andhra Pradesh and Orissa are separated by the abrupt ascent of the Eastern Ghats to the north of the Godavari river. This region has very fertile soil. When contrasted with the

Western Ghats, the Eastern Ghats have a far longer geologic history. This continent's origin is intricately intertwined with the formation and breakup of the ancient supercontinents Rodinia and Gondwana, which occurred at around the same time.

A range of mountains known as the Eastern Ghats may be seen stretching from Orissa to Tamil Nadu, from the Mahanadi River in Orissa to the Vagai River in Tamil Nadu. The Eastern Ghats are the mountains that form the eastern frontier of the broken Deccan plateau along the Bay of Bengal. They stretch from the Mahanadi river basin in the north for around 500 metres all the way down to the Nilgiris in the south. The mountain range known as the Eastern Ghats may be seen stretching from the state of West Bengal in the north to the state of Tamil Nadu in the south. During their voyage, they stop at the states of Orissa and Andhra Pradesh. "They are traversed by the Godavari, Mahanadi, Krishna, and Kaveri rivers, which are the four most important rivers in southern India. Because of these rivers, the Eastern Ghats may be broken up into a number of distinct peaks. They are cut off from the Bay of Bengal by the lowlands that run down the coast.

Characteristics of Eastern Ghats:

The formation of the Western Ghats occurred much later than that of the Eastern Ghats. The elevation of the Eastern Ghats is much lower than that of the Western Ghats. Its area is around 75,000 square kilometres, according to a preliminary estimate. The hills of Sirumalai and Karanthamalai may be found in the portion of the Eastern Ghats that is located in the most southern part of Tamil Nadu. The mountain ranges of Kollimalai, Pachaimalai, Shevroy, Palamalai, and Mettur may be found in the northern part of Tamil Nadu. The Kalrayan Hills are also

located in this area. The Eastern Ghats are known for being very fertile, which is one of the region's most notable features. As the Ghat rises above sea level, it becomes the watershed for several rivers. Better harvests may be obtained from the fertile soil as a consequence of the increased rainfall. The Eastern Ghats provide its residents access to the abundant fishing opportunities along the shore, earning the region the nickname Estuaries of India. Thus, the Eastern Ghats are just as ecologically significant as the Western Ghats.

(a) Northern section-

1. Between Mahanadi and Godavari. Only in this section does it display the mountaineering nature that it has.
2. Locally, it is referred to as Maliyas and is made up of both khondalites and Charnokites.

(b) Southern Section

1. Dissected due to large numbers of rivers.

2. BiligiriRangan Hills are famous for Sandalwood and Teak forests.

3. Malagiri range is famous for Sandalwood and other valuable timbers.

4. Shevroy hills and Javadi hills are composed of Charnokite rocks.

5. Nallamalla range in the most prominent range of this section whose southern part, the Palkonda range is higher.

6 At the intersection of the Western Ghats, the Eastern Ghats, and the southern highlands stands Nilgiri (Blue Mountain). The Charnokites that make them up are formidable. Aside from WambadiShola (2470 m), the highest peaks are Doda Beta (2637 m) and Makurti (2554

m). Tea, coffee, and rubber are all grown extensively in this region. Located in a vast undulating valley at the foot of Doda Beta, Ooty is the most well-known hill station in all of South India.

Eastern Ghats Flora and Fauna:

Rich flora and wildlife are supported by the many ecological niches and climatic conditions. There are more Asian elephants in the Eastern Ghats than everywhere else in the world. There are also many other huge creatures in the area, including tigers, leopards, gaurs, sambars, and nilgiri tahr. The Ghats are also well-known for their avian diversity. The diverse floral system may also be found in the Eastern Ghats. This is a potential hotspot for discovering useful plants with medical properties.

Eastern Ghats Tribal Population: Savara, Jatapu, KondaDora, Gadaba, Khond, etc. are just few of the many tribes who call this area home. The indigenous inhabitants of this area have a rich and distinct cultural history. These people continue to practise their ancient rituals. Their subsistence continues to be based on hunting and gathering from the forest. These communities have a deep understanding of the land and its bounty, and they make excellent use of the region's medicinal plants as a result.

Western Ghats

The Deccan Plateau is separated from the shore of the Arabian Sea by the Western Ghats, which run along the western coast of India. The mountains begin at the southernmost section of the Tapi River, close to the state line between Gujarat and Maharashtra. It stretches for almost 1600 kilometres, beginning in Maharashtra and ending at Kanyakumari, at the very point of the peninsula in the southernmost state of Kerala.

Mountains, Gaps and Passes

The Western Ghats mountain range is elevated an average of 1,200 metres above the surrounding sea. There are, however, secluded regions where they may reach a height of over 2440 metres. The Satpura Range in the state's north serves as the starting point for the Western Ghats, which extend southward through Goa and into Karnataka. The Sahyadri Mountains are the most notable mountain range in this part of the country. The two mountains in the region that are the highest are Kalsubai, which stands at 1646 metres, and Salher, which is at 1567 metres. Two of the numerous crossings and gaps that may be found in the Western Ghats are called the Thal Ghat and the Bhor Ghat. Both of these ghats are located in India. They link the countryside of the Deccan to the city of Mumbai. The Nilgiri Mountains, which can be found in the area of the Western Ghats that is situated in the south, serve as the dividing line between the Western and Eastern Ghats. The Nilgiri Mountains tower spectacularly above the lowlands that are located all around them and enclose the Karnataka Plateau between their folds. Both Dodabeta and Makurti are the highest peaks in the Western Ghats, and both can be found in the Nilgiri Hills. Dodabeta stands at 2637 metres, while Makurti also stands at 2637 metres (2554 m). The Palghat gap is a mountain range that stretches from east to west and is what divides the Nilgiri Hills from the rest of the Ghats. The Palghat gap, which spans the Western Ghats and has a breadth of 24 kilometres, provides a handy path through the mountain range. Hills known as Annamalai, Cardamom, and Palni may be found to the south of the Nilgiris mountain range. The Anaimudi mountain range is the highest point in Peninsular India. Because of its elevated position at

2695 metres, it has a commanding presence over the surrounding terrain in Annamalai.

To the north of the Western Ghats is where you'll find the Konkan Coast, while to the south of the Western Ghats is where you'll find the Malabar Coast. This is the location of Pune, which is the largest city in the surrounding mountain range.

Climate and Rainfall

The Western Ghats' lower reaches are characterised by a humid, tropical environment. The climate is milder in higher altitudes (1,500 m and above in the north, and 2,000 m and above in the south). The average annual temperature fluctuates between 24 and 20 degrees Celsius, depending on latitude. The winds have a significant effect in the Western Ghats' seasonal cycle, significantly altering the region's climate. These winds bring the monsoons in the summer and give a calming impact in the winter. The Western Ghats block the passage of the monsoon clouds that bring torrential rain to India from June to September. This causes the windward side to get much more precipitation, often between 3,000 and 4,000 mm and sometimes as much as 9,000 mm. However, in the rain-shadow eastern part of the Western Ghats, annual precipitation is just about a thousand millimetres. The Coromandel Coast is located in the rain shadow of the Western Ghats and, as a result, gets much less precipitation than the rest of India during the summer southwest monsoon.

Significance of peninsular plateau: The Peninsular region of the Indian subcontinent is the oldest and most stable part of the continent. Copper, mica, iron, coal, and many more minerals may be found there in substantial amounts. Black, rich soil, ideal for cultivating cotton, covers most of the northwestern plateau.

Tea, coffee, rubber, millets, spices, etc. may all be grown well in different regions. The Western Ghats' rivers have excellent potential for hydroelectric power development and irrigation system expansion.

COASTAL PLAINS

From Kutch to Orissa, the coastal lowlands that line the plateau are of varying widths. The eastern coastal plains are more wider and flatter than their western counterparts, with the noteworthy exception of Gujarat. The western coast has a thin alluvial edge dotted with mountainous topography. The picturesque Lagoons in the south provide variety to an otherwise indented landscape. In contrast, the eastern coast has a broad plain where the main rivers' deltas have fully grown. Interesting variations in the east coast's alluvial characteristics may be traced back to the climate change that occurred between the north's south-west monsoon regime and the south's north-east monsoon regime.

Eastern Coastal Plains

The Eastern Coastal Plains cover a huge region that is rather flat and may be found between the Eastern Ghats of India and the Bay of Bengal. It is possible that this continent stretches up to a width of 120 kilometres. The eastern coastal plains may be found between the state of Tamil Nadu in the south and the state of West Bengal in the north. The eastern coastal plains are drained by rivers, which have resulted in the formation of river deltas in the valleys. The eastern coastal plains may be broken down into six different sections in their entirety. The six regions that make up India's eastern coastal plains are referred to as the Mahanadi Delta, the Southern Andhra Pradesh Plain, the Krishna and Godavari deltas, the Kanyakumari Coast, and the Coromandel and Sandy Coastal areas. All of these regions are located in the

southern part of the country. The deltas that are formed by several of India's rivers may be found in the lowlands of the nation. These lowlands get their water supply from a number of rivers, including the Mahanadi, Godavari, Kaveri, and Krishna. The Northeast and Southwest monsoons are responsible for the majority of the region's annual precipitation, which ranges between 1,000 and 3,000 millimetres on average. The width of the plains varies anywhere from 100 to 130 kilometres. Carnatic is the term given to the region that is located between the Krishna and Kaveri rivers, while Northern Circars is the name given to the region that is located between the Mahanadi and Krishna rivers.

The eastern coastal lowlands are characterised by high levels of humidity and temperatures that often exceed 30 degrees Celsius. In addition, the region reaps the advantages of abundant precipitation, with yearly totals that often surpass 3000 millimetres (mm). It is also important to keep in mind that the rain that falls on the eastern coastal plains comes from both the northeast and the southwest monsoons throughout the right times of the year.

It has three broad divisions:-

(i) **Utkal Plains:** - It encompasses the Mahanadi delta and Orissa's coastline region in its entirety. The most notable feature is Chilka Lake, which holds the title of being India's biggest lake.

(ii) **Andhra Plains:** - From the Utkal Plains in the north to the Pulicat Lake in the south, it stretches in this direction (Sriharikota Island is in this lake). The delta that was formed by the confluence of the Godavari and Kaveri rivers is the most notable aspect of this region. It also features Lakana Lake.

(iii) **Tamil Nadu Plains:** - It begins with Pulicat Lake and continues all the way to Kanyakumari. The Kaveri delta is the most significant feature. Because of its excellent soil and extensive irrigation systems, it serves as the granary of South India, where rice is the most important crop.

Its characteristics are-

1. The east coast plain is broader and dryer (gets less rainfall), compared to the west coast plain.
2. There are areas of salty soil and sand dunes that are constantly moving.
3. characterised by a lack of rain.
4. PYAN GHAT is the name given to it in both Madras and Andhra Pradesh.
5. Pulicat Lake, which is located close to Madras, is a typical lagoon that is now cut off from the ocean by the island of Sriharikota (an old beachridge).
6. The construction of a baymouth bar led to the formation of Chilka Lake, which is located to the south of the Mahanadi delta. Because the Bhargavi and the Daya rivers both empty into the lake during the monsoon, the water in the lake is naturally pleasant.

Western Coastal Plains

Between the western coast of India and the WesternGhats hills is a narrow coastal plain of around 50 kilometres (31 miles) in width. Gujarat in the north and Kerala in the south mark the beginning and end of the plains. The states of Maharashtra, Goa, and Karnataka are also included. In contrast to the broad eastern coastal plain, the western coastal plain of India occupies a relatively limited stretch of land. Backwaters and rivers abound

in these regions, which stretch from northern Gujarat to southern Kerala across a distance of 50 kilometres. The western coastal plains of India are characterised by the estuaries formed by the rivers that pour into the area. When compared to their eastern cousin, the western coastal plains are far more compact. Konkan, Kanara, and the Malabar Coast make up the western coastal lowlands.

Some important facts

North Circars: Between the Mahanadi andthe Krishna River.

Carnatic: Between the Krishna and theCauvery river

Coromandel: Between the Cauvery riverand Kanyakumari.

Sub-divisions of the Coastal Plains:

(i) **Kutch Peninsula -**

1. It was an island surrounded by seas andLagoons, Later it became a part of mainland

and developed as a broad plain bythe sediments deposited by Indus riversystem.

2. It is made of tertiary rock system.

3. Due to the scarcity of rain and flowingsurface water it has been developed asarid and semi-arid Landscape and, thus,the work of wind is predominant.

(ii) Kathiawar Peninsula -

1. It is made of Deccan Lava.

2. In central part, Mandav hills lies fromwhich small streams radiates in all direction.

3. Mt. Girnar, (of volcanic origin) is thehighest point.

4. The Gir range having dense forest andfamous as the home of Gir lion, is locatedin the southern part.

5. Most of hills like Osem hills, Barda hills,etc. are of volcanic origin.

(iii) **Gujarat Plain -**

1. Lying east of Kathiawar; slopes westwards.
2. The eastern part is made of alluvium andin fertile enough to support agriculturewhile western part is mostly covered bywind blown loess which after weatheringhas given rise to semi-arid Landscape.

(iv) **Konkan Plain -**

1. Lies south of Gujarat plain; stretchesfrom Daman to Goa.
2. It is characterised by cliffs of basalticrocks.
3. The submerged forests near the Bombaycity suggest that the sea level rose on the
Konkan coast in the past.

(v) **Karnataka Coastal Plains -**

1. Stretches from Goa to Mangalore.
2. Maximum width is found nearMangalore.
3. Sharavati is the chief river, which makesGersoppa (Jog) falls before entering theplain.

(vi) **Kerala Plain (Malabar Plain) -**

1. Stretches from Mangalore toKanyakumari.
2. Much wider & less hilly than Karnatakaplain and other plain.
3. Presence of Lakes, Lagoons, Backwaters,spits etc. is a significant characteristic of
Kerala coast.
4. Rivers are short and many of them dryup in summer.

Significance of coastal plains

Crops of all kinds are cultivated on the rich soil that covers most of India's coastal plains. The staple food of these regions is rice. Coconut trees are a coastal staple. The ports account for almost 98% of total commerce volume. The coastal communities of

Gujarat rely mostly on fishing for a livelihood, while the lowlands are well-known for their salt production.

THE INDIAN ISLANDS

While there are plenty of islands close to the coast of India, the Indian Ocean is also home to two major clusters of islands hundreds of kilometres from shore. Both the Andaman and Nicobar Archipelago in the Bay of Bengal and the Lakshadweep Islands in the Arabian Sea are examples of such archipelagos. As more and more major nations grow interested in the geopolitics of the Indian Ocean, research into these islands has become crucial.

Located between 6° 45′ and 13° 45′ North and 92° 10′ and 94° 15′ East, the Andaman and Nicobar Islands form an arcuate chain with a maximum width of around 58 kilometres. The total land area of this archipelago is roughly 8249 square kilometres, and it is made up of 265 large and tiny islands. There are really two groups of islands that make up the whole chain. The Great Andaman Islands in the north are separated from the Nicobar Islands in the south by the Ten Degree Channel. There are around 203 islands that make up the Andaman. With a length of 260 km and a width of 30 km, its total area is 6596 sq km. The Andaman Islands are separated into three distinct regions: the North Andaman, the Central Andaman, and the South Andaman. Duncan Passage, which is 50 km in width, separates the Little Andaman Islands from the Great Andaman Islands.

There are a total of around a dozen larger and smaller islands in the Nicobar archipelago. They span a total area of 1,653 sq. km. with a maximum length of 262 km and a maximum width of 58 km. As its name implies, the Great Nicobar is the biggest of the

Nicobar Islands, spanning 50 by 25 kilometres. In terms of distance from Indonesia's main island of Sumatra, it is the southernmost.

Tertiary sandstone, limestone, and shale make up the bulk of these islands, which are supported by basic and ultrabasic volcanoes. North of Port Blair, on the islands of Barren and Narcondam, volcanoes may be found. Some of the islands have coral reefs that run along their shores. Some of them are quite fragmented, while others are covered in dense woods. Many of the islands have significant elevations due to their rugged terrain. The highest point is Saddle Peak (737 m) in North Andaman. Although its name roughly translates to one lakh islands, the Lakshadweep archipelago in the Arabian Sea consists of just 25 tiny islands. About 200-500 kilometres south-west of the Keralacoast, they are dispersed throughout an area of 108.78 sq kms spanning from 8° - 12° 20′ N - 71° 45′ 74° E. The Amendivi Islands are located north of 110 degrees north latitude, whereas the Cannanore Islands are located south of same latitude. The island of Minicoy may be found quite far to the south. All of these islands are made entirely of coral, and their perimeters are protected by reefs. Minicoy, with 4.53 square kilometres in size, is the biggest and most developed of the islands. Bitra covers a tiny 0.12 square kilometres. The majority of the islands are rather flat, with no peaks higher than five metres. Hills, streams, valleys, and other forms of relief are noticeably absent from their geography. Their western coast is characterised by shallow lagoons, while their eastern coast has higher hills.

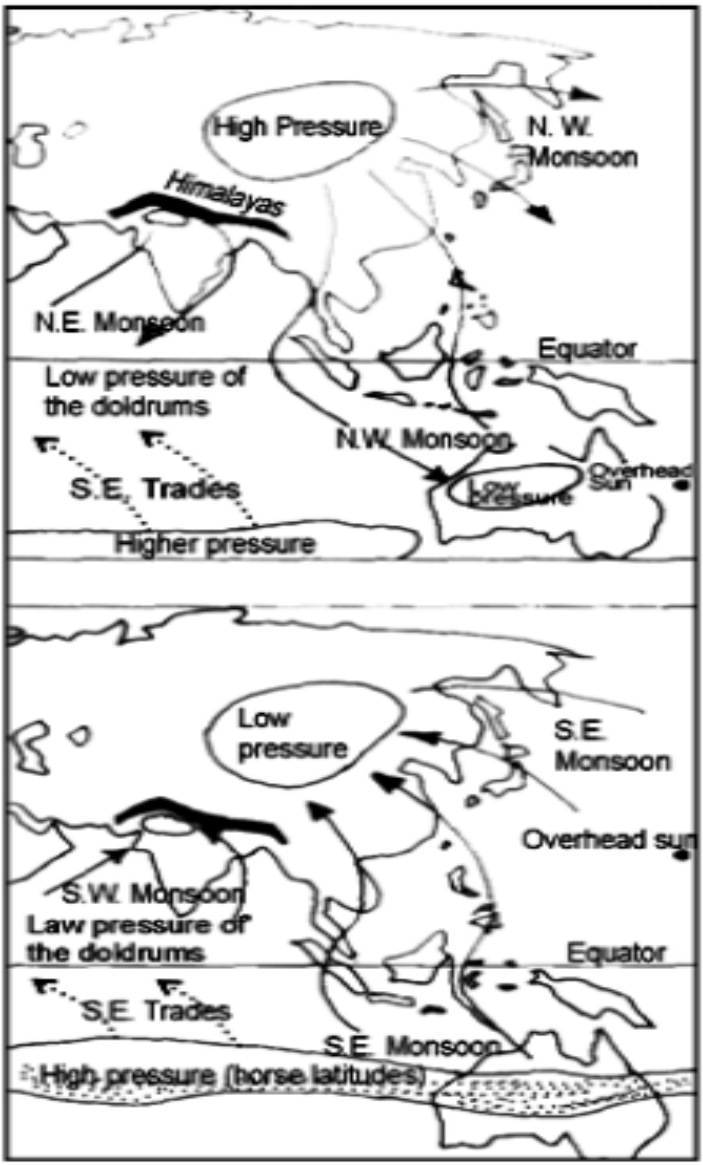
CLIMATE OF INDIA

India is a country of varying topography and climatic conditions. India is a peninsula that protrudes southward from the main Eurasian continent. India has tropical, subtropical, and temperate climate zones. Although the northern section of the nation is in the temperate zone, India is mostly a tropical country. The southern shores of India have a typical tropical monsoon climate due to the influence of the Indian Ocean and its branches, the Arabian Sea and the Bay of Bengal.

FACTORS DETERMINING THE CLIMATE OF INDIA

1. **Location and Latitudinal Extent:** The geographical heart of India is directly on the east-west axis of the Tropic of Cancer. India's climate zones are divided thusly, with the subtropical and temperate north and the tropical south. Because of its proximity to the equator, the tropical zone has year-round warm temperatures that vary little from day to day or month to month. Because of its distance from the equator, the region north of the Tropic of Cancer has a climate that varies greatly both daily and annually.
2. **Distance from the Sea:** The Indian peninsula is surrounded by the Arabian Sea and the Bay of Bengal, which moderate the climate in those places. Extreme weather is common in inland regions of India because they are so far removed from the sea's calming impact. As a result, the average yearly temperature difference between Kochi and Delhi is 20 degrees, although it seldom rises over 3 degrees in Kochi.

3. **The Himalayas:** The Himalayan Mountains act as a barrier between India and the icy, dry winds that blow from Central Asia in the winter. Furthermore, these hills physically prevent the rainy south-west monsoon winds from penetrating India's northern borders. Therefore, the Himalayas separate the warmer climates of the Indian Subcontinent from those of Central Asia.
4. **Physiography:** The climate of India has strong ties to the country's physical map. Ooty, situated in southern India, has a mild climate because to its high elevation. Similarly, although both Agra and Darjeeling are situated on the same latitude, Agra has a much warmer 16°C in January compared to Darjeeling's much cooler 4°C. The wind's velocity and direction, as well as the total and spatial distribution of precipitation, are all influenced by India's topography. Rainfall is most between June and September on the windward slopes of the Western Ghats and Assam, whereas the southern plateau is dry for the same reason. The Cherrapunji valley, which has the form of a funnel, is the wettest spot on Earth because of its physical features.
5. **Monsoon Winds:** The 'Monsoonwinds' are the single most important contributor to India's weather, hence the country's climate is often referred to as the Monsoon Climate. It rains all throughout the nation during the summer because of the southwest monsoons that blow in from the Arabian Sea and the Bay of Bengal. After picking up moisture from the Bay of Bengal, the northeastern winter monsoons go from land to sea and don't produce significant precipitation elsewhere except along the Coromandel coast.


High Pressure
N. W. Monsoon
Himalayas
N.E. Monsoon
Equator
Low pressure of the doldrums
N.W. Monsoon
S.E. Trades
Overhead Sun
Higher pressure
Low pressure
S.E. Monsoon
Overhead sun
S.W. Monsoon
Law pressure of the doldrums
Equator
S.E. Trades
S.E. Monsoon
High pressure (horse latitudes)

6. **Upper Air Circulations:** Modifications to the flow of air over the Indian subcontinent have a significant impact on the country's weather.

(i) **Westerly Jet Stream:** The winds from the west continue to blow throughout all of Western and Central Asia between 9 and 13 kilometres in height from west to east. We call them Jet Streams in the jargon. The Tibetan plateau blocks these prevailing winds. This causes jet streams to split in two. It splits into two halves, one of which blows north of the Tibetan highlands and the other east of the Himalayas. Western disturbances from the Mediterranean area are carried by this jet stream's southern branch and are thought to have a significant impact on India's winter climate.

(ii) **Easterly Jet:** The apparent summertime northward movement of the sun's vertical rays causes a reversal in upper air circulation. When the Tibetan plateau warms up, the westerly jet stream is displaced by the easterly jet stream. This results in the formation of an easterly jet stream across the peninsula of India, centred at around 15°N in latitude. This is useful for when the southwest monsoons start up all of a sudden.

Tropical depressions are guided to India by the easterly jet stream. These low pressure areas are crucial in determining where the monsoon rains will fall throughout the Indian subcontinent.

7. **Tropical Cyclones:** The Bay of Bengal and the Indian Ocean are the birthplaces of tropical cyclones. The coasts of Tamil Nadu, Andhra Pradesh, and Orissa are impacted by these tropical cyclones, which bring tremendous wind speeds and heavy rainfall. High wind speeds and heavy rain make cyclones particularly dangerous.

8. **Western Disturbance:** During the winter months, the westerly jet stream brings disturbances from over the Mediterranean Sea to the west and northwest of the Indian subcontinent. They have an impact on the winter climate of the Northern Plains and Western Himalaya.
9. **El-Nino Effect:** The narrow warm stream known as El Nio sometimes takes the place of the cold Peru current. The result is widespread flooding and drought in the world's tropical areas. El-Nino is blamed for the terrible drought that hit India in 1987.
10. **La Nina:** The resumption of regular weather patterns after an El Nino is referred to as La Nina. When La Nina is present, India may expect a lot of rain during the monsoon season.

INDIAN MONSOON

The Arabic term MAUSIN, meaning season, is whence we get the English word monsoon. Therefore, monsoons are seasonal winds that blow in the opposite direction at different times of the year. In the summer, they flow inland, and in the winter, they drain into the sea. There are two main schools of thought when it comes to the monsoons.

1. Classical theory: When describing the phenomenon known as the monsoon, Halley pointed out the importance of the disparity in temperature between the land and the ocean. The sun's vertical passage over the tropic of cancer in the summer causes high temperatures and low pressure in central Asia, whilst pressure over the Arabian Sea and the Bay of Bengal remains high enough". This occurs when pressure is still high enough over the Arabian Sea and the Bay of Bengal. This results in an increase in the flow of marine air, which in turn dumps copious quantities of precipitation on India and the countries that

surround it. During the winter months, the sun rises and sets at angles that are very acute above the tropic of Capricorn. When this occurs, the monsoon moves in the opposite direction, causing the Arabian Sea and the Bay of Bengal to have a lower average temperature than the region in the northwest of India. There was a lack of an effect that could be attributed to the rotation of the Earth on the physical universe.

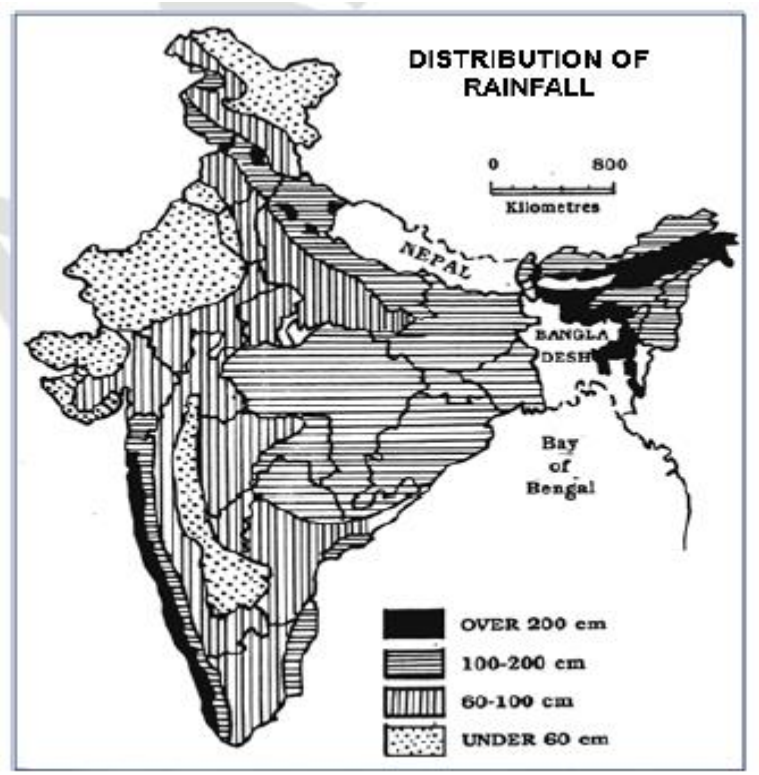
2. Modern theory:

a) Role of ITCZ; According to his interpretation, the FEOHN monsoon is nothing more than the sun-following seasonal movement of planetary winds. He asserts that the major cause of the Asian monsoon is not the difference between land and sea but rather the seasonal movement of thermally produced planetary winds and pressure belts that are influenced by continental impact. After passing across the equator, the trade winds that blow from the southeast in the southern hemisphere switch directions and begin to blow from the southwest to the northeast. This is because of the force of Coriolis. The south-west monsoon winds, which are essentially displaced trade winds, are responsible for bringing the monsoon season to the region.

b) Role of jet streams; This idea was first proposed by M.T.Yin, who claimed that the flow of air at high altitudes was responsible for the monsoon's sudden onset. The monsoon winds are influenced by two major jet streams.

• In the northern hemisphere's upper troposphere during the winter, the subtropical westerly jet stream is the dominant flow pattern. It may be found above southern Asia at an altitude of roughly 12 kilometres and spans the globe between latitudes 25 and 32 degrees north. The Himalayas act as a divider between

the jet stream and the rest of the atmosphere. Over the northwest of India, winds often blow downward, creating a calm climate.



• The equatorial easterly jet stream may be seen as a belt of strong easterlies spanning from south-east Asia across the Indian Ocean and Africa to the Atlantic Ocean during the Indian monsoon season.

The jet streams that originate in the Pacific Ocean and the Atlantic Ocean collide in the vicinity of the Himalayas, both to the north and to the south. The south-western monsoon builds

up pace once the eastern jet becomes stronger and finds a stable position.

c) Role of Tibetan plateau, The Tibetan plateau extends for more than 2,000 kilometres above sea level and is 600 kilometres wide to the west and 1,000 kilometres wide to the east. One of the most important aspects in the evolution of the monsoon is this plateau. The Tibetan plateau acts as a mechanical barrier in addition to a high temperature plateau. The latent heating over the Tibetan plateau causes an anticyclone to form in the upper troposphere. It causes a pocket of rising air, which then moves outward and settles slowly across the Indian Ocean's equatorial region. It is responsible for precipitation in India and neighbouring nations by bringing moisture from the Indian Ocean.

Characteristics of Monsoonal Rainfall

(i) The southwest monsoons provide predictable rainfall between the months of June and September.

(ii) Relief or terrain has a significant role in determining monsoonal rainfall. For instance, the Western Ghats get around 250 centimetres of rain on their windward side. The Eastern Himalayas and the mountain ranges to the northeast are to blame for the region's abundant precipitation.

(iii) Rainfall during the monsoon season decreases inland from the coast. It rains a total of 119 centimetres in Kolkata, 105 in Patna, 76 in Allahabad, 56 in Delhi, and 24 in Bikaner during the southwest monsoon.

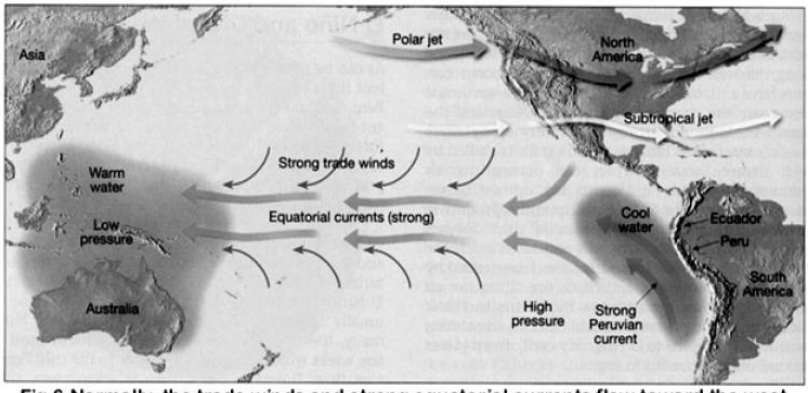


Fig.6 Normally, the trade winds and strong equatorial currents flow toward the west. At the same time, an intense Peruvian current causes upwelling of cold water along the west coast of South America.

(iv) Breaks are a defining feature of the monsoon downpours. These dry spells are linked to cyclonic depressions that occur at the northern end of the Bay of Bengal and move inland. These troughs occur anywhere from twice to four times a month between the months of June and September. The distribution of precipitation is also dependent on the passage followed by these depressions, in addition to their frequency and severity.

(v) Summer rains tend to arrive in torrents, causing flooding and soil degradation.

(vi) Over three-quarters of India's annual rainfall occurs during the southwest monsoon season, making it the most important season for the country's agricultural sector.

(vii) Its height varies greatly from 12 centimetres in western Rajasthan to more than 400 centimetres in Meghalaya.

(viii) Sometimes the start of the rains is much later than usual throughout the nation or in a particular region. Sometimes the rains stop far earlier than normal, which is disastrous for any crops that have already matured and makes it impossible to seed winter crops. This is why the monsoons are so hard to anticipate.

Rainfall distribution

1. **Areas of very high rainfall (annual rainfall of 200cm and above)**

The western shore from southern Thiruvananthapuram to northern Mumbai is one example (Avg. annual rainfall 200 - 400 cm). Parts of Manipur, Tripura, and the northeastern point of West Bengal, as well as almost the whole state of Assam, get 200cm or more of precipitation annually, while a few locations even see over 400cm. Meghalaya, often known as The home of clouds, receives the most annual rainfall in India, with 1221cm and 1102cm at Mawsynram and Cherrapunji, respectively.

2. **Areas of High rainfall (100-200cm annual rainfall)**These a large portion of the northern plain, the states of Orissa, Madhya Pradesh, Andhra Pradesh, and Tamil Nadu, and the eastern slopes of the Western Ghats.

3. **Areas of Low rainfall (50 - 100 cm annual rainfall)**

The eastern portion of Rajasthan, the state of Punjab, the state of Haryana, and a portion of the Indian state of Uttar Pradesh.

4. **Areas of very Low rainfall (Less than 50 cm of annual rainfall)**

These regions are deserts or near-deserts. Most of the Ladakh region of Jammu & Kashmir and a significant portion of Western Rajasthan are among these areas.

WESTERN DISTURBANCES

Throughout the months of October through June, the northern part of the Indian subcontinent is in the path of middle latitude cyclones due to the southern movement of the polar front during the winter. During the other months, the tracks go far to the pole, avoiding the Indian subcontinent.

Temperate cyclones, also known as western disturbances, form in western Asia and the Mediterranean Sea before making its way eastward over India. These storms in the west are responsible for

- ✓ Heavy snowfall in the Himalayas
- ✓ The rabi crop has benefited from the rains in the northwestern plains.
- ✓ Hail and a quick drop in temperature characterise this phenomenon.

LOCAL WINDS

In the summer, the nation as a whole has low atmospheric pressure. May and June are the hottest months of the year in North West India, creating a steep pressure gradient and resulting in strong, dusty winds.

a) **LOO:** Mornings and afternoons are the prime times for these scorching, dusty breezes. Because of this, the surrounding air becomes hot and humid.

b) **AANDHIS:** Essentially, they are thunderstorms that advance like a wall of dust and sand. There is a strong wind blowing, and visibility is down to a few metres at best. The states of Rajasthan, Haryana, Delhi, Uttar Pradesh, etc., are often hit by dust storms. Storms that come from the north west are known as NORWESTERS in West Bengal and the neighbouring states of Jharkhand and Orissa.

c) **KAL BAISAKHIS:** Storms of this magnitude are very damaging to crops, animals, and people. The months of March and April are peak times.

WATER RESOURCES AND DRAINAGE PATTERN

Water is crucial to the survival of all forms of life and the smooth functioning of the natural world. To produce power for residential, commercial, and industrial usage, as well as for human and animal consumption (in the form of drinking water, household cleaning, transportation, industry, leisure, and animal husbandry). Water is a precious resource that has to be protected and preserved in light of the many difficulties it may cause when it is misused, wasted, or loses quality.

Water Resources of India

India is blessed with an abundance of water resources, including rivers, estuaries, groundwater, and the ocean. One of a country's most valuable resources is its water supply. About 4,000 cubic kilometres of precipitation per year is average for India. Mousinram, which is close to Cherrapunji and gets the most rainfall in the world, has a severe water scarcity during the dry season virtually every year, highlighting the paradoxical nature of India's rainfall. It is estimated that 1953 km3 of water flows through the rivers of India each year on average. There are estimated to be 432 km3 of yearly replenishable groundwater resources.

India is expected to have yearly utilisable surface water resources of 690 km3 and yearly utilisable groundwater resources of 396 km3. The water supply is becoming more stressed as the global population rises and people raise their level of life. At the same time, the amount of water available per person is decreasing.

The nation has the issue of flood and drought syndrome because of the geographical and temporal variability in precipitation. As a result of excessive pumping, river flows have decreased, groundwater supplies are depleting, and salt water is seeping into aquifers in coastal regions. Some of the command areas have become waterlogged and salty as a consequence of excessive canal irrigation. Increasing pollution loads from both point and non-point sources are also degrading surface and groundwater resources. Precipitation and water supply are two areas where climate change is predicted to have an impact.

India has been blessed with a vast river network that includes over 20 main rivers and many smaller rivers that feed into them. Some of these rivers only flow seasonally, while others flow year-round. From the Himalayas flow perennial rivers including the Ganges, Brahmaputra, and Indus. During the dry season, the snow and ice melt from the Himalayas and the base flow combine to provide the flows. There are more than 50 percent of India's water resources in the tributaries of these rivers. Snow and glacier melt from the high mountains contribute significantly to the water supply of the Himalayan rivers, since their average water production per unit area is about twice that of the south peninsular rivers system.

Groundwater is a significant supply of potable water, irrigation water, industrial water, etc., in addition to the water found in the country's rivers. It supplies water for more than 45% of the country's total irrigation and is responsible for providing water for 80% of homes' needs. According to international standards, a country is considered water stressed if its annual per capita water availability is less than 1700 m3, and water scarcity if it is less than 1000 m3.

WATER CONSERVATION

As a monsoon region, our nation experiences rain for just three to four months out of the year. Since surface water is in short supply for the most of the year in India, water conservation is essential. There are fewer sources of water to go around, so we have to conserve what we have. This includes water from rain, the earth, the sea, ponds, and rivers. As a result, the government has published a plethora of soil and water conservation programmes aimed at enhancing and constructing superior water supply infrastructure.

Groundwater and Surface water management

An efficient groundwater management strategy that prioritises efficiency, justice, and sustainability is necessary to safeguard the aquifers from overexploitation. India has a big rural population and very dispersed agricultural holdings. It is important to manage the use of groundwater resources so that we don't deplete them faster than they can be replenished and so that everyone benefits from them equally. Over-exploitation of groundwater has negative environmental implications that must be adequately avoided by Federal and state governments.

Seawater intrusion into freshwater aquifers may be prevented by avoiding excessive groundwater withdrawals, particularly in coastal areas. Obviously, a potential answer is a joint management model that combines government administration with active public engagement. Bore-well drilling should be limited in severely overexploited regions until the water table rises to the required level. Urgent action is required to undertake artificial recharge procedures in these regions. When compared to other recharge methods, percolation tanks have the lowest upfront expenses. There are already a great number of these

tanks, but the overwhelming majority have been silted up. In such a circumstance, they may be reused after being cleaned in the tank's bed. Increasing the availability of groundwater will be greatly aided by encouraging community participation in the rehabilitation of recharge tanks. Wells often run dry and the cost to pump groundwater has risen as the water table has dropped. This places a significant monetary strain on farmers. Therefore, targeted assistance programmes for these farmers are required.

For groundwater development to be fair and sustainable, the government's role must shift from regulator to facilitator.

The primary objective of the Government of India has been to provide irrigation via a large canal infrastructure network, and this has been the case from the first five-yearplan all the way through the seventh five-yearplan. Water logging is a concern in several irrigation project commands, including the ones for the Sarda Sahayak in Uttar Pradesh, the Gandakin in Bihar, the Chambal in Rajasthan, the Nagarjuna Sagar in Andhra Pradesh, the Ghataprabha and the Malaprabha in Karnataka, etc. The fundamental reason for the overuse of surface water instead of groundwater is that surface water is more cheaper to irrigate than groundwater. If both surface and groundwater were used together, flooding issues may be resolved. In waterlogged places, using groundwater for irrigation may assist bring the water table down and the land can be reclaimed. Mehsana, Gujarat; sections of Meeurt and Varanasi districts in Uttar Pradesh; Coimbatore, Tamil Nadu; the Karnal district of Haryana; etc. have all experienced groundwater mining due to their excessive use. The reasons of waterlogging have been the topic of several studies. The assessment of waterlogged regions and methods for preventing waterlogging and salinization have

been the topic of several groundwater flow modelling research. Prudent use of available canal water in combination with groundwater is preferred to meet irrigation demands for satisfying agricultural water requirements and maintain an adequate water table level.

Therefore, water logging and groundwater mining may be reduced by making the most of the region's surface and groundwater resources simultaneously.

Rain water harvesting

Harvesting rainwater allows for its controlled use and conservation by preventing wasteful runoff, evaporation, and seepage. Rainwater collection has several advantages, including:

• It increases water availability

• It checks the declining water table

• It is environmentally friendly

• It improves the quality of groundwaterthrough dilution, mainly of fluoride, nitrate,and salinity, and

• It prevents soil erosion and flooding,especially in the urban areas.

Recycle and reuse of water

Reusing and recycling water is another strategy for increasing the supply of potable water. Every drop of water is purportedly recycled eight times in the German city of Frankfurt. Water of lower quality, such as reclaimed wastewater, is an appealing choice for cooling and fire fighting in big and complicated enterprises because it allows them to minimise their water expenses, enhance their productivity, and decrease their energy usage. This helps to preserve water of higher quality for human consumption. There is a lot of room for growth and motivation

to adopt this strategy since water recycling is not yet widespread in India.

Drip irrigation

Drip irrigation is a method of delivering water to a crop's root zone by use of a system of porous or perforated pipework that may be put above or below ground. These methods drastically reduce the amount of water lost through evaporation (about 5 percent). As a result, compared to gravity-based systems, this one may reduce water use by as much as 60 percent.

LEPA

With the LEPA technique, water is dispersed to plants through drop tubes attached to the sprinkler's arm. This technology, when combined with other water-saving practises, may yield efficiencies of up to 95%. The low pressure at which this technology works results in a 20-50% decrease in energy expenses when compared to more traditional systems.

DRAINAGE SYSTEMS OF INDIA

Hundreds of great and minor rivers drain the whole length and width of India. A total of 18, 58,100,000,000 cubic metres of water is produced annually by the country's rivers, with 33.8% coming from the Brahmaputra, 25.2% from the Gang, 6.4% from the Godavari, 4.3% from the Indus, 3.6% from the Mahanadi, 3.4% from the Krishna, and 3.4% from the Narmada (2.9 percent).

On the basis of the origin of rivers, theIndian drainage syst em can broadly be divided into–

(1) The rivers that flow from the Himalayas, such as the Indus, Brahmaputra, and the Ganges, and their tributaries, And

(2) Mahanadi, Godavari, Krishna, Cauvery, Narmada, Tapi, and their tributaries make up the river system of the Peninsula.

Similarly on the basis of orientation to the sea, the Indian drainage system can be divided into -

(A) The Bay of Bengal drainage

(B) The Arabian sea drainage.

Major rivers like the Ganga, Brahmaputra, Mahanadi, Godavari, Krishna, Cauvery, Penneru, Vaigai, etc. all drain into the Bay of Bengal, while the Indus, Narmada, Tapi, Sabarmati, Mahi, and a slew of other fast-moving western coast rivers that originate in the Sahyadris drain into the Arabian Sea, making up about 23 percent of the country's drainage area. The Bay of Bengal receives more than 90% of the water that flows down India's rivers; the other 10% goes to the Arabian Sea or creates inland drainage. The orientation is heavily influenced by the distribution of water.

HIMALAYAN RIVER SYSTEMS

Important features:-

• The rivers in the Himalayas are a wonderful example of antecedent drainage since they existed long before the Himalayas were raised. Rivers like the Indus, Satluj, Alaknanda, Bhagirathi, Brahmaputra, and Kosi all have deep gorges that attest to this. Most of them are also not caused by the Himalayan mountain range.

• These rivers are perennial because they are nourished by the Himalayas' massive snowpack. They get plenty of rain and are at full capacity when the monsoons hit.

• Due to the geologically unstable conditions and friable nature of the terrain, they tend to take unpredictable and erratic paths, meander, or change direction dramatically.
• Because of their developmental stage, the valleys include many rapids, waterfalls, and cascades.

Evolution of the Himalayan drainage

Scientists think that during the Miocene epoch, a massive river known as the Shiwalik or Indo-Brahma flowed from Assam through the Punjab and Sind before emptying into the Gulf of Sind close to modern-day Lower Punjab. This theory is supported by the Shiwalik's exceptional continuity and its lacustrine origin and alluvial deposits of sands, silts, clays, boulders, and conglomerates. It is speculated that the Indo-Brahma river eventually split into three major tributaries:

(i) the Indus and its five tributaries in thewestern part;

(ii) the Ganga and its Himalayan tributaries inthe central part; and

(iii) the easternmost section of the Brahmaputra River when it meets its Himalayan tributaries in Assam. It is likely that the upheaval in the western Himalayas during the Pleistocene, namely the elevation of the PotwarPlateau (Delhi Ridge), which separated the Indus and Ganga drainage systems, was responsible for the breakup. Similarly, the mid-Pleistocene downthrusting of the Malda gap region between the Rajmahal hills and the Meghalaya plateau redirected the Ganga and Brahmaputra systems to the Bay of Bengal.

The Indus System

With a total size of 1,178,440 square kilometres (including 321,290 square kilometres in India), the Ganges River Basin is one of the world's biggest river basins (in India 709 km). The

Indus, sometimes spelled Sindhu, is the Indian river that flows westward from the Himalayas.

The Indus begins in the glacier at a height of 5,182 m in the Kailash Mountains, which is located near the Tibetan town of Bokhar Chu (31°15' N latitude and 81°40' Elongitude). Until it meets the Dhar, it is known as the Lion'smouth, or Singe Khamban, in Tibet. It crosses into India between the Ladakh and Jaskar mountain ranges, where it continues flowing northwest. Only in Jammu and Kashmir's Leh area does India's Indus River flow. The river has a relatively mild slope (30 cm per km). The Shyok, Gilgit, Gortang, Zaskar, Hunza, Nubra, Shigar, Gasting, and Dras are only few of the rivers that feed into it.

After crossing into Pakistan from the Dardistan area around Chillar, the Indus meets the Kabul River on its right bank as it emerges from the hills near Attock. The Khurram, Tochi, Gomal, Viboa, and Sangar are further significant tributaries that flow into the Indus from the right bank. The Sulaiman Mountains are their point of origin. The river bends to the south and picks up the name Panjnad about north of Mithankot.

Water from the Jhelum, Chenab, Ravi, Beas, and Satluj rivers in Punjab is collectively referred to as the Panjnad. The Indus River empties into the Arabian Sea to the east of Karachi. Kalabagh measures an annual average flow of 110,450 million cubic metres for the Indus River. The Jhelum, a significant Indus tributary, begins its life in a spring in Verinag, in the valley's extreme southeast, at an elevation of 4,900 metres. From the Wular lake and on into Srinagar, it heads north. The river makes a sharp turn southward in Muzaffarabad, where the Kishenaganga joins it on the right bank. After forming the border between India and Pakistan for 170 kilometres, it emerges on the

Potwar plateau close to Mirpur. The Lidar, Sind, and Pohru are its major tributaries, all of which originate in the Kashmir Himalayas. At Mangala, the annual average volume of the Jhelum River's flow is 27,890,000,000 cubic metres. At Trimmu, close to Jhang in Pakistan, it flows into the Chenab. The Chenab, the greatest Indus tributary, is produced when the Chandra and Bhaga rivers meet, close to the town of Tandi in Himachal Pradesh's Keylong district. Locals also call it Chandrabhaga. It originates in the Himalayas and travels northwest through the Pangi valley into Jammu and Kashmir. Plain meets the Chenab River in Akhnur. It takes the river 1,180 kilometres to reach Pakistan. At Marala, the Chenab river has an average annual flow of 29,000,000,000 cubic metres of water. It flows into the Satluj River in Pakistan near Panchnad.

The Kullu highlands, in Himachal Pradesh, are where the Ravi first emerges, not far from the Rohtang Pass. The land between the Pir Panjal and the Dhauladhar peaks is drained by this river as it flows to the northwest. It crosses into Pakistan 26 kilometres south of Amritsar, in the Punjab plains at Madhopur. Sarai Sindhu, which is close to Rangpur, is where it meets the Chenab. At Madhopur, it has an annual flow of 8 billion cubic metres. Near the Rohtang Pass, at an altitude of around 4,050 metres above sea level, is where the Beas begins its journey downstream. Gorges are carved out by the river at Kati and Lorji in the Dhauladhar mountain as it winds through the Kullu valley. Near Pong, it reaches the Punjabi lowlands. The river then turns south-west and joins the Satluj close to Harike. Beas at Mandi has an average yearly flow of 15,800,000,000 cubic metres.

The Mansarovar-Rakas Lake, also known as LangchenKhamban in Tibet, is the source of the Satluj, an antecedent river. It begins

near Darma Pass at an elevation of 4,570 m. It enters India at the Shipki LaPass after running almost parallel to the Indus for 400 kilometres. It carved up a chasm 900 metres deep in Tibet's NariKhorsan region. At Namgia, it meets its most important tributary, the Spiti. “This river is crucial since it supplies water to the canals that are part of the BhakraNangal project. It turns west after entering the plains at Rupar and meets the Beas near Harike. It is the 120 km border between India and Pakistan that runs from Ferozepur to Fazilka. The 1,050 km of its 1,450 km entire length that it runs across India. Its yearly average flow rate is 16,600,000,000 cubic metres per year at Rupnagar (Rupar).

The Ganga River System

From the Gangotri glacier at Gaumukh (7,010 m), the Bhagirathi flows down to become the Ganga. The Satopanth Glacier, located not far from Badrinath, is the origin of Alaknanda, the second headstream of the Ganga. The Alaknanda is made up of the Vishnu Ganga and the Dhauli, both of which come together in Joshimath. The Alaknanda river converges with

- The Dhauliganga river at Vishnuprayag,
- The Pindar river at Karnaprayag,
- The Mandakini or Kali Ganga atRudraprayag and finally
- The Bhagirathi river at Devprayag.

Devprayag is where the river Ganges is born. Haridwar, a holy city on the Gangetic Plain, is where the Ganga finally emerges after travelling 280 kilometres from its origin. To irrigate the Doab area of Uttar Pradesh, part of its waters are diverted here to the Ganges Canal. It is here that the Ganges, which has been flowing approximately southwest until now, turns southeast across the plains of northern India. The river winds its way for

770 kilometres through Kanpur and eventually meets the Yamuna in Allahabad, which originates in the southwest. Between Allahabad and Malda in West Bengal, the Ganges receives a lot of help from other rivers including the Kosi, Son, Gandak, and Ghaghra, creating a strong stream. The cities of Varanasi, Buxar, Patna, and Bhagalpur are among those it travels through. The river turns south in Bhagalpur, after winding through the Rajmahal Hills.

The Hooghly River starts its gradual attrition near Pakur, where it receives its first distributary, the Bhagirathi-Hooghly. In order to maintain the Hooghly relatively free of silt, the Farakka Barrage, which was constructed in 1974 and is located close to the border with Bangladesh, regulates the flow of the Ganges. There will be two barrages constructed as part of the Farakka barrage project, one spanning the Ganga at Farakka and the other spanning the Bhagirathi at Jangipur.

Padma River is the name given to the primary Ganges tributary after it enters Bangladesh and continues on to Goalundo, where it meets the greatest distributary of the Brahmaputra, the Jamuna River.

Meghna River, the second biggest tributary of the Brahmaputra, runs into the Meghna Estuary on Sagar island, changing its name to Meghna along the way.

The Ganga flows through four different countries: Uttarakhand (310 km), Uttar Pradesh (1140 km), Bihar (445 km), and West Bengal (520 km). Bihar and Uttar Pradesh are separated by the remaining 110 kilometres of the Ganges. The Yamuna's principal right bank tributaries are the Sonare and the Jamuna. From west to east, the most significant tributaries to the river's

left bank are the Ramganga, Gomati, Ghaghara, Gandak, Kosi, and Mahananda.

The Yamuna, the Yamnotri glacier on the western slopes of the Banerpunch range is the source of the Ganga's longest and westernmost branch (6,330 m). In the Himalayas, it meets up with smaller rivers including the Rishiganga, Uma, and Hanuman Ganga. Near Kalsi, Tons connects with it. In Tajewala, it crosses into the plains. On its right bank, which begins on the Peninsularplateau, it meets the Chambal, the Sind, the Betwa, and the Ken; on its left bank, it meets the Hindon, the Rind, the Sengar, and the Varuna. Prayag is where it meets the Ganges (Allahabad). From its source to its final destination in Prayag, the Yamuna is 1,376 kilometres long. Much of its water supplies the irrigation canals of Agra and the western and eastern Yamuna.

The Chambal originating in the Janapao hills close to Mhow on the Malwa plateau in Madhya Pradesh, and flowing north via the Kota gorge above theGandhisagar dam in Rajasthan. It begins in the city of Kota, travels through the districts of Bundi, Sawai Madhopur, and Dholpur, and then converges with the Yamuna at the U.P. city of Etawah. The Chambal is well-known for the badland ravines that characterise the region. There are a total of 1,050 kilometres of river. At SawaiMadhopur, the Banas join it.

The Sind starts in the Madhya Pradesh Vidisha plateau. It travels 415 kilometres before finally emptying into the Yamuna.

The Betwa begins its journey in the Bhopal area and eventually meets the Yamuna close to Hamirpur, a distance of 590 kilometres. Its major tributary is the Dhasan.

From its source in the Barren Range of Madhya Pradesh flows the 360-kilometer-long Ken. Near Chila, it meets the Yamuna.

The Son flows south from the Amarkantakplateau and becomes a major tributary of the Ganga. It then curves to the northeast after plunging over a series of waterfalls near the plateau's edge. It travels west of Patna to Arrah, where it meets the Ganga. The Son is fed by many significant rivers, including the Johilla, Gopat, Rihand, Kanhar, and North Koel.

The eastern Chotanagpur Plateau is home to the Damodaros, and the river runs through a rift valley before merging with the Hooghly. Its most important tributary is the Barakar. Damodar Valley Corporation, a multifunctional river project, has helped tame the river formerly known as the sorrow of Bengal for its terrible floods.

The Ramganga is a very unimportant river that originates in the Garhwal hills in the vicinity of Kalagarh. After flowing to the northeast till it reached the Shiwalik Mountains, it performs a U-turn and heads in the direction of the southwest until it enters the plains of Uttar Pradesh near Najibabad. It finally joins up with the Ganga not far from Kannauj. The Khoh, Gangan, Aril, and Kosi rivers as well as the Deoha river are its most important tributaries (Gorra).

The Ghaghara River originates in the glaciers of Mapchachungo, which are located south of Mansarovar and adjacent to the peaks of GurlaMandhata. Karnali is the name given to the river that flows across western Nepal. It emerges from the mountain near Shishapani, which is where it carves a deep valley in order to collect the waters of its tributaries, which include the Tila, the Seti, and the Beri.

On the plain, it converges with the river Sarda, often known as the Kali or Kali Ganga, just before it reaches Chhapra and joins

the Ganges. There are also additional branches of it, such as the Sarju and the Rapti. It has a flow rate that is around 94,000,000,000 cubic metres per year on average.

The Milan Glacier in the Nepal Himalayas is the source of the Goriganga, also known as the Sarda or Saryu River. It is known as Kali at the border between India and Nepal. When you get to the plain around Tanakpur, you'll know you've arrived at Chauka. After then, it swings to the southeast to meet up with the Ghaghara.

There are two rivers that make up the Gandak—the Kali Gandak and the Trishul Ganga. It originates between Dhaulagiri and Mount Everest in the Nepal Himalayas and empties into the Terai plain in the country's central region. In Nepal, Gandak is called Narayani. It originates in the Champaran area of Bihar and flows into the Ganga plain, where it meets the Ganga in Sonpur, close to Patna. The yearly average volume of flow is 52.2 billion m3. Mayangadi and Bari rivers are its most significant feeders.

The western slopes of the Sumesar hills near the Indo-Nepal border are the source of the BurhiGandak, which thereafter flows to the south-east. Near Monghyr, it connects to the Ganga. It's 610 kilometres long.

The Kosi is a tributary of the Arun, whose primary source is located in northern Tibet near Mount Everest. The Sun Kosi from the west and the Tamur Kosi from the east meet it after the river has made its way through the Central Himalayas in Nepal. At Triveni, it combines with the Arun to produce SaptKosi. The river quickly slows down after debouching onto the plain because of the weight of its cargo. The river's channel is braided and it regularly changes its path. The resulting floods are

catastrophic. This is why the Kosi is sometimes referred to as the Sorrow of Bihar. In 1965, the HanumanNagar barrage was built to control the river. Around the town of Kursala, the Kosi flows into the Ganga.

The Brahmaputra River System

The Brahmaputra is one of the largest rivers in the world, and its water originates from the Chemayungdung glacier, which is located in the Kailash range. The Mariam La passes are what stand between its beginning and the Mansarovar Lake. The Tsangpo River, whose name roughly translates to the purifier, then runs more than 1,200 kilometres eastward across a dry and flat region of southern Tibet from this point. The Rango Tsangpo, which originates in northern Tibet, is the river's most important and major tributary. After carving its way through a deep gorge in the Central Himalayas not far from Namcha Barwa, the river emerges as a turbulent and busy canal farther downstream (7,756m). The name of the river as it makes its way down from the highlands is either Siang or Dihang. It enters India southwest of the town of Sadiya, which is located in the state of Arunachal Pradesh. The Dibang or Sikang and the Lohit, both significant left bank tributaries, give rise to the Brahmaputra, which then flows to the southwest before merging with the Ganges. During its passage through the Assam valley, which is around 750 kilometres long, the Brahmaputra gathers water from a number of smaller rivers. On the right bank, notable tributaries include the Subansiri, Kameng, Dhansiri (north), Manas, and Sankosh. On the left bank, significant tributaries include the BurhiDihing, Noa Dihing, Dhansiri (South), Dibru, Dikhu, and Kalang. Beginning its journey in Tibet is the river known as the Subansiri. Dhubri is the point at which the

Brahmaputra River enters Bangladesh from the south. Because the Tista River, which originates in Bangladesh, empties into it, the Jamuna River got its name from Bangladesh.

At some point, it will converge with the Padma River, which, in turn, flows into the Bay of Bengal.

Along the Brahmaputra, it is not uncommon for there to be flooding, shifting of the channel, and erosion of the banks. This is due to the fact that the catchment area gets a significant amount of rainfall, which causes the majority of the rivers that flow into it to be very sizeable and bring a significant quantity of silt with them. Because of its abrasion-prone channel, the river in Assam is responsible for creating Majuli, which is the largest river island in the world.

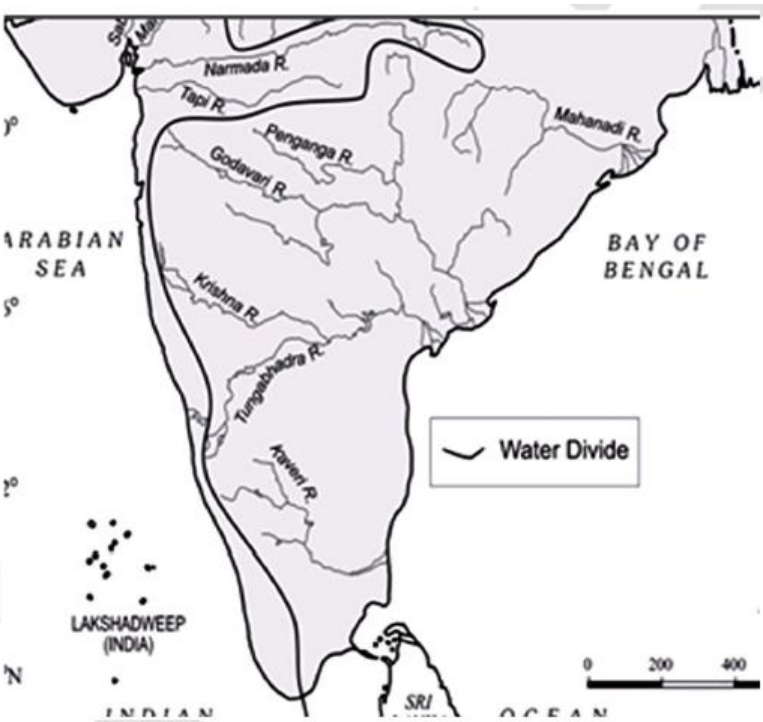
THE PENINSULAR DRAINAGE SYSTEM

The drainage system that drains the Peninsula is older than the one that drains the Himalayas. This may be observed in the established rivers as well as the expansive valleys that have a gentle slope. The Western Ghats, which are mountains that run parallel to the western coast, are what define the watershed that separates the major Peninsular from the Tapi rivers, which flow through the rift valley. There are a few significant exceptions to this rule.

Evolution of the peninsular drainage

The current drainage networks of Peninsular India were influenced by three significant geological events:

(i) The Peninsula was completely submerged in the early Tertiary due to subsidence along its western flank. In most cases, it has thrown off the original watershed's symmetrical layout for the river.



(ii) The Himalayas erupted as a result of trough faulting caused by subsidence on the northern flank of the peninsular block. The Narmada and the Tapi both flow through faults, which they then fill with debris. This means that these rivers do not include any significant deltaic or alluvial deposits.

(iii) During this time, the Peninsular block was slightly tilted from the northwest to the southeast, orienting the whole drainage system toward the Bay of Bengal.

The Peninsular River Systems

Important features of the Peninsular River system:

• The peninsula's rivers have flatter watersheds and less seismic activity to blame for their lack of meanders.

• The river channels are at their lowest points and their slopes are minimal.
• Greater river size results in greater deltas (except those flowing towards west).
• The peninsular rivers have been there for a much longer than the Himalayan rivers, as shown by their vast, mainly graded, and shallow valleys.
• Because the peninsula's major watershed is in the Western Ghats, which are located relatively near to the west coast, most of the peninsula's rivers flow to the east. The rivers Narmada and Tapi stand out because they flow counter to this pattern.
• The peninsular drainage has several river systems. Peninsular rivers often flow in one of three directions:
(i) The Bay of Bengal receives water from the Mahanadi, Godavari, Krishna, Cauvery, and a number of smaller rivers emptying from the south and southeast.
(ii) Several smaller rivers and streams that begin in the Western Ghats also drain westward into the Arabian Sea.
(iii) North-easterly directions are followed by the Chambal, Sind, Betwa, Ken, Son, and Damodar, which are all rivers that feed into the Ganges and the Yamuna.

The East Flowing Rivers of the Peninsula

The Mahanadi starts its voyage from its source in Sihawa, which is located in the Raipur district of Chhattisgarh. The river then travels through Orissa before entering the Bay of Bengal. It stretches over a total distance of 851 kilometres and has a catchment area that spans over 1.42 million square kilometres. Navigation takes place on this river on the segment that is the lowest. This river's basin discharges 47 percent of its water into the state of Orissa and 53 percent into the states of Madhya

Pradesh and Chhattisgarh. The Ib, Mand, Hasdo, and Sheonath rivers are considered to be tributaries of the left bank, whilst the Ong, Jonk, and Tel rivers are considered to be tributaries of the right bank. On this section of the river is the Hirakud Dam, which holds the record for being the longest dam in the world.

One of the most important rivers in the peninsula is called the Godavari. Additionally, it is referred to as the Vridha Ganga and the Dakshin Ganga. Its source, the Triambak plateau, provides the water for this river, which runs through the Nasik district of Maharashtra and finally empties into the Bay of Bengal. The tributaries of this river go through the Indian states of Maharashtra, Madhya Pradesh, Chhattisgarh, and Orissa, as well as Andhra Pradesh. It has a length of 1,465 kilometres and a catchment area of 3,13,000 square kilometres, of which 49% is situated in the state of Maharashtra, 21% in the states of Madhya Pradesh and Chhattisgarh, 24% in the state of Andhra Pradesh, and the remaining 3% is in the state of Orissa.

The only tributary that flows into the Nizam Sagar dam is the Manjra, which is located on the right side. Its primary left bank tributaries are the Penganga, Wardha, Wainganga, Indravati, Pranhita, and Sabari.

The Godavari is created when three rivers—the Penganga, the Wardha, and the Wainganga—confluence. The Indravati river originates in the Kondhan hills, which are located in the Eastern Ghats. The Godavari River, in its lower stages, produces a lovely valley to the south of Polavaram. However, this valley is susceptible to severe flooding. Only the last three hundred kilometres of the route over the delta may be travelled. After Rajamundri, a huge delta of the Lobate type develops, and the

Godavari River splits into two branches, the Gautami Godavari to the east and the Vashishtha Godavari to the west.

The Sahyadri Mountains in Mahabaleshwar are the place where the Krishna River, which travels in an easterly direction and is the second largest river on the peninsula, begins its journey. Totaling 1,400 km in length. Its Koyna, Muneru, Ghatprabha, Malprabha, Tungbhadra, Musi, and Bhima branches are considered to be its most significant offshoots.

About 27 percent of the catchment area for the Krishna River is located in the state of Maharashtra, 44 percent in the state of Karnataka, and 29 percent in the state of Andhra Pradesh.

The Brahmagiri Hills in Karnataka, which are located close to Taal Kaveri, are where the Kaveri river originates. It stretches for a total of 800 kilometres and must drain a region that is 81,155 square kilometres in size. The upper section of the river's catchment area receives precipitation during the southwest monsoon season (summer), while the lower section receives precipitation during the northeast monsoon season. As a result, the river's water level remains relatively consistent throughout the year in comparison to the water level of the other peninsular rivers (winter).

The Sivasamudram Falls are located at the point where the river that originates on the South Karnataka Plateau enters the Tamil Nadu Plains. A river island known as Srirangam has travelled about the equivalent of one-half of its whole distance. The Indian states of Kerala and Karnataka have each staked a claim to 3% of the Kaveri basin, whereas Tamil Nadu has staked a claim to 56% of the basin. Important tributaries include the Herangi and Hemavati rivers located in the north, as well as the Lakshamantirtha and Kabini rivers located in the south, as well

as the Suvarnavati, Bhavani, and Amravati rivers. The Subarnarekha, Brahmani, Penneru, Ponnaiyar, and Vaigai are the other peninsular India rivers that flow to the east, and they are listed in order from north to south. The Brahmani river is formed when the Koel and Sankh rivers come together close to Rourkela. It receives water from the Kura, the Sankhad, and the Tikra rivers. Rivers such as the Jayamangli, the Kunderu, the Saigileru, the Chitravati, the Papagni, and the Cheyyeru all converge into one larger river known as the Penneru. The Baitarni, the Vamsadhara, and the Palar are three further important rivers.

The West Flowing Rivers of the Peninsula

The Narmada, which is the largest river in the peninsula that flows to the west, originates on the western slope of the Amarkantak plateau, which is located at a height of around 1,057 metres. Marble Rocks and the Dhuandhar waterfall in Jabalpur, which is situated in a rift valley between the Satpura and the Vindhyan mountains, are both found along its path as it winds through a breathtaking canyon. Further waterfalls are formed at Mandhar, Dardi, and Maheshwar as a result of this (Sahasradhara Falls). Following its 1,310-kilometer journey, the river finally discharges its waters into the Arabian Sea south of Bharuch, where it creates a broad estuary that stretches for 27 kilometres and is known as the Gulf of Khambhat. It has authority over about 98,796 square kilometres of land. The Sardar Sarovar Project has been established along the banks of this river. The Hiran, the Orsang, the Barna, and the Kolar are the principal rivers that flow into the right bank of this river. A number of significant tributaries may be found on the left bank, including the Burhner, Banjar, Shar, Shakkar, Kundi, and Tawa.

The Tapti, which is usually referred to simply as the Tapi, is the second-largest river that travels in a westerly direction. It is the twin of the Narmada as well as the handmaid of the Narmada. The city of Multai, located in the Betul district of Madhya Pradesh, is where everything got started. Its length is 730 kilometres, and it drains an area of land that is 65,145 square kilometres in total. The states of Maharashtra and Madhya Pradesh make up about 80 and 20 percent of its basin, respectively, while Gujarat is responsible for the remaining 6 percent. Around Bhusawal, the Purnajoining, which is the river's most significant tributary, flows into it. The Khursi, Girna, Bori, and Panjhara rivers all begin their journeys on the left side of the river, whilst the Betul, Patki, Aner, and Gomai rivers enter from the right.

The Luni is the largest river system in Rajasthan, and it is located to the west of the Aravalli Mountains. At Pushkar, it forks into the Saraswati and the Sagarmati, and the confluence of these two rivers takes place not far from Govindgarh. In this region, the river is known as the Luni, and the Aravalli Mountains are its birthplace. It continues to the west until it reaches Telwara, at which point it makes a sharp bend to the south and continues on until it reaches the Rann of Kuchchh. There is no such thing as a permanent river system.

The Sabar and the Hathmati rivers come together to create what is often referred to as the Sabarmati river.

It flows into the Gulf of Khambhat and has its beginnings in the Aravalli Mountains, which are located close to the town of Mewar. Its offshoots include tribes such as the Sedhi and the Meshwa, amongst many others.

The Vindhya Mountains serve as the headwaters for the Mahi River, which ultimately empties into the Gulf of Khambhat. Although to varied degrees, Madhya Pradesh, Rajasthan, and Gujarat are all included in its drainage basin, the territory is shared by all three states (34 percent). It receives water from the Som, Anas, and Panam rivers, amongst others.

rivers of the Sahyadri range that flow in a westerly direction

The rivers that flow into the Arabian Sea have rather rapid currents and are not very long until they discharge into the sea. However, they are responsible for the movement of 18% of India's freshwater while only affecting 3% of the country's land area. The course of the Kalinadi River starts in the Belgaum area of Karnataka and continues all the way to the Karwar Bay at the conclusion. Hubli Dharwar is the location from whence the Bedti River starts its journey of 161 kilometres. There is another a prominent river in the state of Karnataka called the Sharavati, which flows in a westerly direction. It originates in the Shimogadistrict and drains an area that is 2,209 square kilometres in total catchment area. The Sharavati River is responsible for the creation of the breathtaking Jog or Gersoppa Falls, which are the highest in India. Near the village of Aniali, in the Rajkot region of Gujarat, is where the Bhadra river first emerges. The Vaitarna starts its climb up to its final height of 670 metres in the Triambakin Nasik neighbourhood. There are a number of rivers in Goa that are noteworthy. Their names are Mandovi, Rachol, and Juari, respectively.

The coastline of Kerala is not very wide. Near the Annamalai hills is where the Bharathapuzha river, which is Kerala's longest river, starts its voyage. It is also known by the name of Ponnani. In altogether, it drains 5,397 square kilometres. The Periyar is

the second-largest river in Kerala, which is a state that has several rivers. It covers an area that is 5,243 square kilometres in size. There are a number of rivers in Kerala that are notable, including the Pamba River, which has a total length of 177 kilometres before it empties into Vembanad Lake, the Beypore River, and the Pannam River.

DRAINAGE PATTERNS

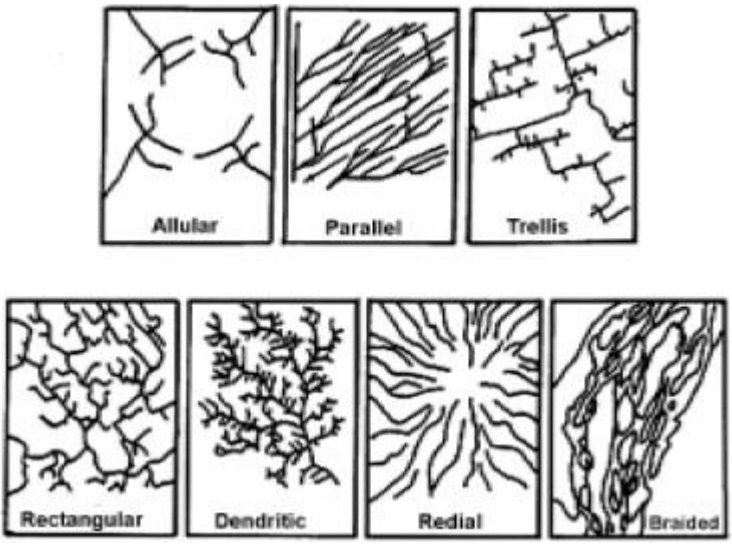
Streams, rivers, and lakes in a given area create a pattern called a drainage system. They are controlled by the terrain's topography, including the prevalence of hard or soft rocks and the inclination of the ground.

Types of drainage system

1. **Dendritic drainage system:** The vast majority of drainage systems are dendritic drainage systems. Many smaller streams (equivalent to the branches of a tree) come together to form the larger tributaries of the main river in a dendritic system (the branches and thetrunk of the tree, respectively). They form in areas where the river channel follows a natural gradient. The V-shaped valleys formed by dendritic systems need impermeable, non-porous rock types. The Indus, Godavari, Mahanadi, Cauvery, and the Krishna rivers are only a few instances of them.

2. **Parallel drainage system:** Rivers run in a pattern called a parallel drainage system when there are steep slopes and some relief. The steep slopes lead the streams to be rapid and straight, with few tributaries and a uniform direction of flow. This kind of system originates on terrain with a consistent slope, such as the rivers draining southeast from Kenya's Aberdare Mountains.

Rivers that originate in the Western Ghats and run swiftly into the Arabian Sea are an example.



3. **Trellis drainage system**: A trellis drainage system's shape is similar to that of a garden trellis, which is often used to train climbing plants like vines. The river follows a striking valley, with smaller streams draining down the mountains' flanks. The drainage system looks like a trellis because these tributaries reach the main river at angles of around 90 degrees. The Appalachians in North America are a good example of a folded mountain range with a trellis drainage pattern. The Singhbhum region of India is home to ancient folded mountains (Chotanagpur Plateau).

4. **Rectangular drainage system:** Rocks having about the same resistance to erosion, but with two directions of jointing that are approximately perpendicular to one another are likely to produce

rectangular drainage patterns. Because joints are often less resistant to erosion than the bulk rock, they are the first to become exposed when erosion occurs, and this is where streams finally originate. This leads to the formation of a network of streams that is characterised by abrupt right-angle turns and straight segments, with smaller streams branching off of larger ones at right angles. The Vindhyan Mountains of India, for example, are home to a number of rivers and streams.

5. **Radial drainage system:** Streams in a radial drainage system fan outward from a central peak. Radial drainage is often quite good around volcanoes. Radial drainage also forms often on domes and laccoliths, two other typical geological structures. These topographic highlights often display a hybrid of radial and annular drainage patterns. The Narmada, Son, and Mahanadi rivers, all of which begin in the Amarkantak Hills, all head in separate directions. There is a similar radial drainage system in the Girnar Hills (Kathiwar, Gujarat) and the Mikir Hills (Assam).

6. **Deranged drainage system:** A disordered drainage system is one in which the rivers and lakes flow in random directions within their respective drainage basins. It occurs when there has been significant geological upheaval. The Canadian Shield is the prototypical case in point. Most of the dirt was removed during the previous ice age, exposing the underlying rock. The melting of the glaciers created topographic anomalies, causing water to pool in low areas and giving rise to Canada's numerous lakes. The watersheds are very new, thus they are continually

developing and maturing. The system will reach a steady state at some point.

7. **Annular drainage pattern:** Streams that have an annular drainage pattern frequently flow in a ring-like pattern in plan view, winding their way in a roughly circular or concentric path around a band of weak rock. This kind of stream drainage is called an annular drainage pattern. Streams that drain a maturely dissected structural dome or basin, where erosion has revealed rimming sedimentary layers of considerably differing degrees of hardness, are excellent examples. The Red Valley, which completely encircles the domal structure of the Black Hills in South Dakota, is another example. Both of these examples are in the United States. Kerala, Pithoragarh (which is located in Uttarakhand), and the Nilgiri Hills in Tamil Nadu are just a few instances of the peculiar drainage pattern that can be seen across India.

NATIONAL WATER POLICY 2012

Water is a fundamental component necessary for human existence, as well as for the expansion of the economy, the maintenance of nutritional balance, and the achievement of long-term success. In addition to that, it is a scarce commodity. Despite accounting for just 2.6 percent of the world's total land area, India is home to more than 17 percent of the world's population but only 4 percent of its renewable water resources.

The uneven geographical and temporal distribution of water is another factor that reduces the amount of available water. The annual average precipitation may vary from less than 100 millimetres in certain parts of Rajasthan to more than 10,000 millimetres in Cherrapunji, which is located in Meghalaya.

There are various instances in which rivers and subterranean aquifers pass across multiple states. Every single one of the places where water may be found, from clouds to rivers to lakes to underground aquifers, is interrelated and a component of the same overarching system.

In addition, the country faces challenges due to the recurrence of natural disasters like as droughts and floods. The future water supply will be subject to increasing stresses as a result of a growing population and rising requirements of a rapidly expanding country, in addition to the presented signs of the influence of climate change". This could potentially lead to deeper water disputes among various user groups. People are unaware of how valuable water is and how much it drains the economy because of this, which results in water being wasted and underutilised. In addition to this, there is a lack of a unified strategy in the development, management, and use of water resources, which results in an uneven distribution of the resource.

The purpose of the National Water Policy is to evaluate the current state of affairs and to propose a framework within which a complete set of laws and institutions, as well as a coordinated national action plan, may be established. In addition, the National Water Policy will also make recommendations regarding how these things should be done.

In September of 1987, the establishment of a national policy for water took place. Since then, a number of newly discovered issues relating to the management and cultivation of water sources have emerged. Because of this, in 2012 we revised the National Water Policy that had been established in 1987.

The following are some of the highlights of the new National Water Policy from 2012:

The Draft National Water Policy, 2012 places an emphasis on the necessity of a national water framework law, comprehensive legislation for optimal development of inter-State rivers and river valleys, the public trust doctrine, amendment of the Indian Easements Act, 1882, etc., despite the fact that the Constitution grants the States the right to frame appropriate policies, laws, and regulations on water.

In contrast to plans that are just concerned with meeting minimal flow needs, the Drought NWP, 2012 adopts an ecological point of view. River flows are characterised by low or no flows, small floods (freshets), large floods, and flow variability; all of these characteristics must be taken into consideration while planning for development, in addition to the biological requirements of the river. River flows should be set aside for ecological reasons, with low and high flow releases altered such that they more nearly reflect the natural flow regime over the course of time. The river flows should be set aside for ecological purposes.

It recognises the need of taking into account the effects that climate change will have on projects using water resources at all levels of the planning and development process. Both the criteria for acceptability and the coping strategies for building and managing buildings related to water resources have been examined and discussed.

- The need for doing so and the strategies for doing so have been outlined. The new additional tactics for boosting usable water resources include making direct use of rainwater and avoiding accidental evapo-transpiration.

- The draught calls for periodic updates to a map of aquifers so that the nation may better understand its ground water resources and their quantity and quality.
- We need a system that can create criteria for how much water is used for different reasons, such as water footprints and water audits, in order to be certain that water is being utilised in an efficient manner. This would allow us to ensure that water is being used properly.
- Water Users Associations should be granted the authority to collect and keep a portion of the costs associated with water usage, supervise the management of the volumetric quantity of water that has been allotted to them, and carry out maintenance on distribution systems. This legislative authority should be granted.
- All projects involving water resources, such as hydropower projects, should be built as multi-purpose projects that provide storage in order to make the most of the available terrain and water resources.
- The National Water Policy, 2012 places a focus on being prepared for both flooding and drought, with an emphasis on coping mechanisms as an alternative.
- Inundation maps based on flood frequency should be ready so that adaptation plans may be developed.
- Every river basin needs to have the appropriate institutional arrangements made so that data on rainfall, river flows, irrigated area by crop and by source, utilizations for various uses by both surface and ground water, and water accounts are published on a ten-daily basis throughout the entire year based on hydrologic

balances. This is necessary in order to ensure that water resources are managed effectively.

Numerous socioeconomic factors and concerns must be taken into account during the planning and implementation of water resourcesprojects. These include environmental sustainability, the proper relocation and rehabilitation of people and livestock displaced by the project, public health concerns related to water impoundment, dam safety, and so on.

SOILS

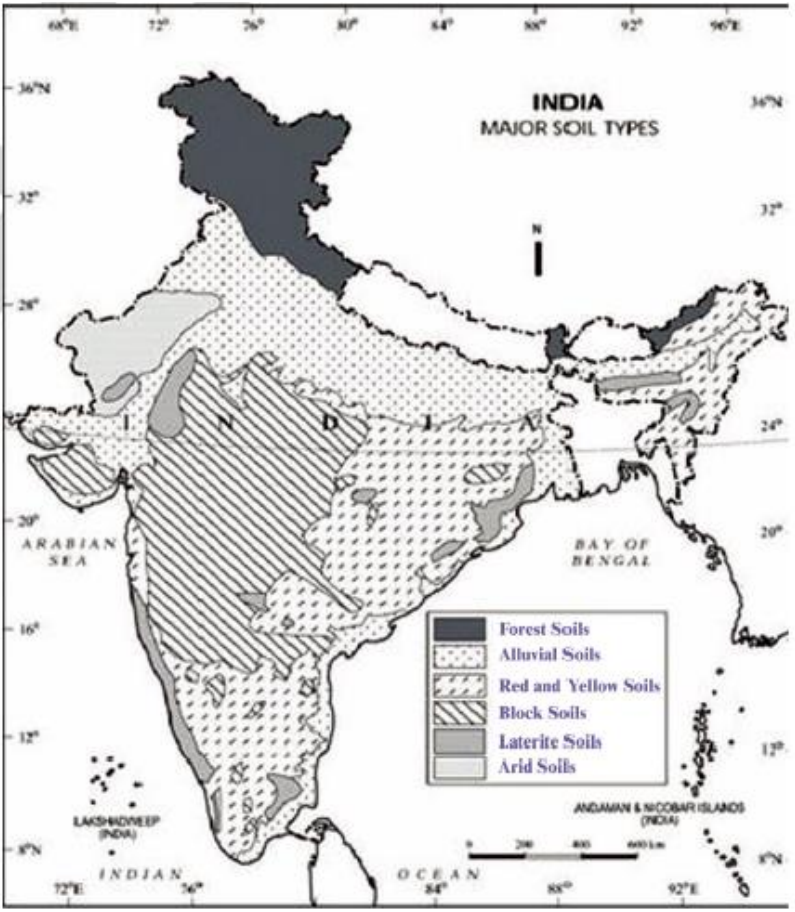
The soil layer is the outermost one on Earth. Small fragments of minerals, organic materials, and microbes are also included. Over aeons of time, rocks become soil as weather, wind, waves, animals, and plants break them down into small fragments. There are four distinct layers to soil. The soil's uppermost layer is composed of tiny soil particles and decomposed plant and animal debris. This layer is critical for agricultural purposes. Fine particles like clay make up the second layer, while weathered soil and basic rock make up the third, and unweathered hard rocks make up the fourth.

The physical, chemical, and biological features of various soils make them ideal for growing a wide variety of crops. Alluvial soil is a high-nutrient, low-salt soil type. Paddy, sugarcane, and plantain are just few of the crops that thrive there. Crops like red gramme, Bengal gramme, green gramme, groundnut, and castor seed thrive in the high iron concentration of red soil. Calcium, potassium, and magnesium abound in black soil, while nitrogen is scarce. Cotton, tobacco, chilli peppers, oil seeds, jowar, ragi, and maize are just few of the crops that thrive there. In locations

with heavy rainfall, trees like the coconut, cashew, and casuarinas may thrive in sandy soil despite its poor nutritional level.

TYPES AND DISTRIBUTION

There is a wide variety of soil types in India due to the country's varied temperature, altitude, and bedrock composition. Soils in the nation have unique features due to factors including the uneven yearly distribution of rainfall and the high average temperature. Alluvial, black, desert, red and yellow, saline, lateritic, and mountain soils are the seven most common kinds of soil in India.



1. **Alluvial Soil:** In terms of importance and prevalence, this is the top dog. It accounts about forty percent of the total land mass. The whole Northern Plains region is comprised of these soils. They have been transported and deposited by the mighty Satluj, Ganga, and Brahmaputra rivers and their tributaries in the Himalayas.

They leave Rajasthan through a narrow spout and make their way into the Gujarati plains. They populate the Mahanadi, Godavari, Krishna, and Kaveri deltas, all of which are found on the eastern coastal plains. Along its lengthy journey, which may span hundreds of kilometres and thousands of years, a river deposits very refined particles of dirt, known as alluvium, on its plains. The proportions of sand, silt, and clay in these soils vary widely. The coastal lowlands and deltas are teeming with them. Soil particles seem to be somewhat larger as one travels inland along river valleys. The soils are rougher at the higher portions of the river valleys, closer to where the rivers begin. Piedmont plains, especially those located at the foot of mountains, are more likely to have such soils.

Age is also a distinguishing feature of soils. Both ancient and modern alluvium are classified here. Some estimates place the age of the so-called new alluvium at over 10,000 years. Bhangar refers to older alluvium, whereas khadar refers to more recent alluvium. Kankar nodules, which are composed of calcium carbonates, are often found in the subsoil of ancient alluvium. When compared to older alluvium, the newer stuff is far more mineral-rich.

Alluvial soils, taken as a whole, are very fertile. Potash, phosphoric acid, and lime are often plentiful in their cargo. However, they are deficient in nitrogenous and organic material. The soils tend to be more alkaline in the drier regions. About half of India's population relies on alluvial soils for their food and agriculture.

2. **Regur Soil/Black soil:** Because of their dark appearance, regur soils are also often referred to as black soils. Cotton soils are another popular term for regur soils owing to the fact that

this particular soil type is ideal for cotton cultivation. The original name for these soils is regur soils. These soils, which are characteristic of the Deccan trap (Basalt) area, cover the section of the Deccan plateau that is located in the northwestern part of the region. After traversing the plateaus of Maharashtra, Saurashtra, Malwa, and southern Madhya Pradesh, they continue eastward via the Godavari and Krishna Valleys in the south.

Clayey substances make up black soils, which are notoriously brittle due to their composition. When the soil becomes wet, the high clay content of Regur causes it to become very sticky, which makes it more difficult to cultivate. It is well knowledge that they have a high capacity for water. In addition to that, the soil is rich in calcium carbonate, magnesium carbonate, potash, and lime. Phosphorus content is often low in these organisms. They begin to break and split open throughout the field as the temperature rises. Because of this, ventilation is improved, which in turn adds to the excellence of their self-ploughing. Unless it is tilled either immediately after the first monsoon rains or before the monsoon rains, this soil is quite dense and difficult to work. Regur soils tend to be found in semiarid locations, especially those that are coated with basalt. Granites and gneisses with iron content also form black soils in the southern region of Tamil Nadu given the proper semi-arid climatic conditions. This is because granites and gneisses are igneous rocks. The Surat and Broach districts, in addition to the Tapti Valley and the Narmada Valley, are all regions where Regur soils are formed. The presence of certain salts has caused the soil to have a black colour, and there is very little humus in the ground. The hilly western part of the nation often has thin, weak,

sandy soils that are black in colour. It is not very usual to find deposits of lime nodules buried under the surface of black soils, which are also referred to as Regur soils. Additionally, the clayey, deep soil that can be found in the plains and in the river valleys is fantastic for storing water and creating a high crop yield. This can be found in both of these regions. It has been stated that the capacity to maintain the moisture level of soil is of significant significance in a practical sense. This indicates that the ability of the soil to hold water increases in proportion to the depth of the soil. On the other hand, the soil in Regur is deficient in nitrogen, which is a nutrient that is regarded to be advantageous to the growth of plants.

Laterite Soil: The western coastal area of India, which receives very strong rainfall, is home to the laterite soils that are often found capping the country's flat uplands. In the northeastern states of Meghalaya and Chhotanagpur, as well as in the northern state of Tamil Nadu, lateritic soils may be found at the border of the plateau. Grasslands and scrub woodlands are about all that the typically weak soils can support. There are primarily two categories of mixed soil types. The Himalayan mountain soils and the arid soils of western Rajasthan are two examples.

Most examples of laterite soil may be found in the tropics, namely in areas that have high annual rainfall. Bauxite is a kind of laterite soil that is characterised by a high concentration of aluminium oxides due to the leaching of silica and lime during periods of heavy rainfall. Laterite soil is often a deep red colour because of the presence of iron oxides. This is an acidic soil because of its low lime concentration. The Eastern Ghats in Orissa are a prime example of the laterite soils that are common in high-rainfall plateau and hilly locations. It is also widespread

in the Ratnagiri District and Malabar parts of the southern Western Ghats.

This soil lacks humus nearly entirely. The laterite soil produced in the western Karnataka forests, on the other hand, contains humus. In addition, the high-altitude laterite soils are notoriously arid and water-poor. However, lateritization is influenced in low-lying places by the periodic influx of soils washed down from neighbouring higher locations. The lateritic soil there is either loam or muck, and it is ploughed often because of its usefulness. Regular fertiliser applications are necessary for sustained crop production.

4. **Red Soil:** Yellow soils are another name for red soils. Red soils, similar to laterite soil, are highly leached and comprised mostly of iron oxides. This soil's distinctive reddish or yellowish colour is due to the presence of iron oxides. Red soils have a higher sand-to-clay ratio and less stony particles. These soils are also less susceptible to leaching than laterite soils since they originate in drier climates. Additionally, metamorphic rocks are often the hosts for soils with a red or yellow hue. No necessary nutrients can be found in red soils.

For instance, they lack appropriate quantities of important nutrients such as nitrogen, lime, and phosphate in their soil. Red soils almost always have conditions that are acidic. Similarities between red soils and laterite soils include this particular aspect. The majority of farming occurs during the months that get higher levels of precipitation since red soils are not very good at retaining moisture. If yields are going to improve, this soil has to have manures added to it on a consistent basis. The Indian peninsular plateau is distinguished by the preponderance of red soils over its whole. Rich and deep red soil may be found in the

lowlands and valleys of the region. On the other hand, those who live on the slopes of the hills are often thin and come from economically deprived backgrounds.

The northern half of the peninsular block is covered in black dirt, while the southern half is covered in red soil that ranges in colour from red to yellow and many shades in between. They ring the whole black soil region as well as the eastern half of the peninsula, which includes the Chhotanagpur Plateau, Orissa, the eastern sections of Madhya Pradesh, the Nilgiris, and the plateau of Tamil Nadu. Additionally, they include the Nilgiris. They go to the north and west of Maharashtra, following the coastline of the Konkan region. Additionally, they may be found in the plateau of Bihar and in Shillong. It is most widespread in Mizoram and Manipur, two of the states in Northeast India. The soil in the lowlands is loamy, whilst the soil in the uplands is gravelly. They function most effectively when fertilisers and irrigation solutions are applied in specified amounts.

5. **Forest and Mountain Soil:** In the Himalayas, you'll find a wide diversity of soil types. Dry and frigid regions like Ladakh, Lahul-Spiti, Kinnaur District, etc. are home to the mountain soils that make up these regions. Also, alluvial soils are common in river valleys and river terraces, whereas slopes often have a variety of soil types. It may be anything from silty loam to shards of rock. River basins and outwash plains often include fine-textured soils. Soils in these hilly areas tend to be rocky and shallow, yet they are deficient in organic matter. Whether a mountain range is located in a warm temperate belt or a cold temperate belt is a major factor in determining the fundamental nature of the soils found there.

The mild temperate belt, between 900 and 1800 metres in altitude, is home to deciduous trees and brown forest soil. Vegetation may decompose in this zone because of the high temperatures present there. The dark, humus-rich soil characteristic of this woodland zone is rather deep. They're employed for growing a wide range of crops since they're fertile and somewhat acidic.

6. Desert soils: Much of the dry land in western Rajasthan, Haryana, and Punjab, between the Indus River and the Aravalli mountain, has recently been impacted by desert conditions. Brown sand blankets this area, and the dry environment does little to help the soil improve. Quartz is the most common mineral in desert sand, although feldspar, hornblende, and even calcareous grains may be found there as well. Minimal precipitation from the monsoon season is experienced there. The sands that blanket the area come from a variety of sources, including the weathering of the underlying rocks and windblown sands from the seashore and the Indus Valley. Some of these soils are rich in soluble salts, have an alkaline pH, are low in organic matter, and have a high or low calcium carbonate content. The desert of Rajasthan is a huge sand plain with occasional outcrops of hills or vegetation. Although sandy throughout, the soil becomes more fertile towards east and northeast. Soils are often saline or alkaline, with high pH and poor physical characteristics, in many areas.

7. Peaty and marshy soil: Humid environments are the birthplace of peaty soil, which forms when significant quantities of organic matter accumulate in the ground. There are a lot of soluble salts and 10–40% organic content in these soils. This category of soils, known as KARI, is endemic to the Kottayam

and Alappuzha districts of Kerala. The coastal regions of Orissa and Tamil Nadu are home to similarly wet and vegetable-rich soil types. The peaty soils are acidic, dense, and black. Both potash and phosphate are in short supply there.

8. Saline and alkaline soils: Both Andhra Pradesh and Karnataka have these kinds of soils. Soils with this tendency are called reh, kallar, usar, rakar, and chopan, and they are prone to saline and alkaline efflorescences. The root zone of these soils is poisoned by high levels of soluble salts. Saturation extracts from these types of soils have an electrical conductivity of more than 4.0 mmhos/cm, indicating the presence of salts. Both the pH and the exchangeable sodium fraction are below 8.5. Sodium, calcium, and magnesium chlorides and sulphates predominate among the soluble salts. The soil is known as white alkali because of the white encrustation caused by the salts. Numerous problems arise when soil is either too salty or too alkaline, or both.

leading to poor harvests or, in the worst scenario, crop collapse

1. Second, not all food can be grown since certain plants are very sensitive to salt or alkalinity or both.

3. A low level of zinc in fodder produced on alkali soils may lead to nutritional imbalance and sickness in livestock, therefore the quality of this feed is reduced.

4. Adding complexity to the creation and maintenance of infrastructure.

5. Damage to crops from heavy runoffs and floods caused by inadequate infiltration.

SOIL EROSION AND CONSERVATION

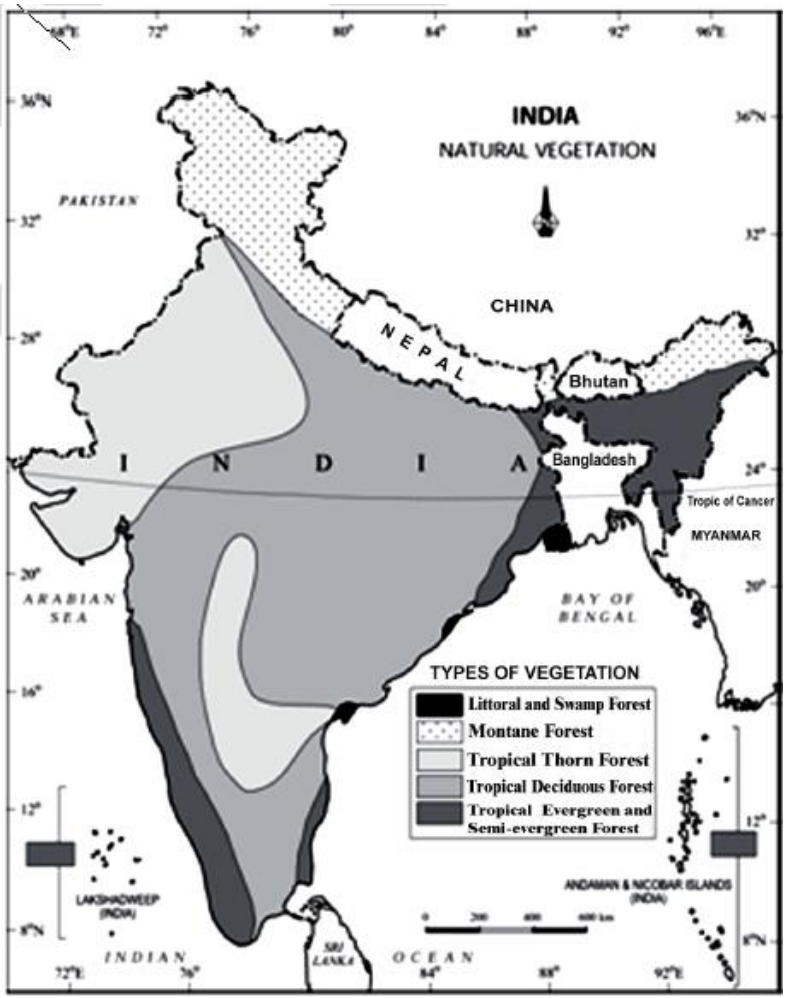
Erosion of the soil is a significant issue in India. Because of things like altering agricultural practises, water logging, gorges and gullies, and other similar things, soil erosion is a huge issue that affects more than 130 million hectares of land, which is about 45 percent of the entire area. When the top layer of soil is washed away, either naturally or as a consequence of human activity such as alkanization, soil salinization, deforestation, and so on, this is known as soil erosion. Soil erosion may happen naturally or as a result of human activity.

It is now commonly understood that soil erosion is a serious danger to human health. This concern has been widely publicised. Wind and water are the two factors that contribute to erosion the most often. The impact of precipitation and runoff water on the ground, followed by the transport of soil particles by the water, are the causes of water erosion. Both erosion and sedimentation are processes that include the separation of soil particles, the transport of those particles, and ultimately their deposition in a new location. Detachments are caused when soil particles get separated from the bulk of the soil as a result of erosional processes. The majority of the land in the country has been degraded, which places a danger on the economic basis of the nation. Out of a total area of 329 million hectares, there are 175 million hectares that have been degraded.

Soil erosion is a widespread problem throughout the nation, although it is most severe in the mountainous areas. Unlike the gentle drizzles, the heavier rains tend to wash away the top layers of soil rather than seeping into it. The steep hillsides increase the eroding strength of the rain water. All exposed slopes are at risk of severe sheet erosion or gullying because the

soils are so thin. The effects of erosion may be negligible in mountainous regions but significant in the lowlands.

Because of this erosion, rivers carry millions of tonnes of sand and debris every year, posing a hazard to the whole Kosi river basin. The cargo is dumped and deposited in the river beds as the river reaches the plains and lower and the stream flow slows. Because of this, river channels become congested, raising the risk of flooding and prompting a change in the river's flow, which ultimately spells doom for the whole countryside. Although a particular soil type may not behave consistently under all situations and no form of soil is fully secure from erosion, the type of soil in India has a significant impact on both surface erosion and deep gullying. “Since sandy, porous soil can absorb a lot of water from regular rains, it is often the kind of soil least susceptible to progressive weathering down by water action in the country. However, if frost or even thin layers of clay slow down the percolation rate, the sandy soils may be shifted quickly due to their lack of binding properties. This time, though, the material's coarseness may lead it to be deposited before being moved very far.



Erosion is exacerbated by deforestation and overgrazing in India. Cattle grazing on grass, herbs, and green shrubs have been largely responsible for the devastation of forests throughout the nation as the population has grown.

Effects of soil erosion

- The slow depletion of fertile soil and agricultural output caused by the disappearance of the top fertile layer of soil.
- Mineral and nutrient extraction from the soil that is lost due to floods and leaching
- a drop in the level of the subsurface water table as well as a reduction in the amount of moisture contained in the soil
- The withering away of vegetation and the proliferation of dry land
- a rise in the incidence of natural disasters such as droughts and floods
- The clogging of river and canal belts with sediment.
- Continuation of the landslide activity
- a detrimental impact on both the economic growth and the cultural advancement

Soil conservation

Keeping soil healthy via different means is what we mean when we talk about soil conservation. Soil erosion, misuse, and chemical pollution are all things that may be avoided with the help of conservation practises. In order to keep soil healthy and protect it from the aforementioned dangers, several different methods are used. In order to manage soil effectively, certain soil conservation techniques are used.

Strategies

Some methods of soil conservation are more suited to agricultural regions, while others are more appropriate for specific types of soil. Listed below are some of the most common techniques used to preserve soil quality.

a) **Planting Vegetation:** This is a great way to preserve soil without breaking the bank. Soil erosion may be considerably reduced by planting trees, grass, and other plants. Soil is

protected from being blown away thanks to plants and trees, both of which contribute to maintain its qualities.

Planting trees and plants in residential landscaping areas is another strategy utilised for soil conservation in urban settings. Herbs, tiny trees, plants with wild flowers, and creepers that create a ground cover are all great options for landscaping.

b) **Contour Ploughing:** Farmers often use a technique known as contour farming or contour ploughing, in which they work across the slope while following the elevation contour lines. By slowing the pace at which water enters the soil, this technique reduces the likelihood of soil erosion caused by runoff.

c) **Maintaining the Soil pH:** Soil acidity and alkalinity may be determined by testing the soil's pH. The addition of basic or acidic contaminants causes soil pollution, which may be mitigated by keeping the soil at an optimal pH.

d) **Soil Organisms:** Plants can't thrive without the organic matter that soil organisms break down and make accessible to plants. Beneficial soil creatures, such as earthworms, may be used to improve soil aeration and plant availability of macronutrients. As a result, the soil improves in fertility and structure.

e) **Crop Rotation Practice:** Organic farmers rely heavily on crop rotation, a soil conservation technique that involves planting a succession of different crops in the same area of soil one after the other. This is done to avoid nutrient depletion and the buildup of infections that may arise when the same plants are cultivated in the same soil year after year.

f) **Watering the Soil:** Watering the soil is just as crucial to its health as watering plants and trees. Wind erosion happens when soil particles are blown away. Soil erosion caused by wind

blowing may be avoided by watering and settling the soil. Drip irrigation systems, which hydrate the soil without causing any runoff, are a popular soil conservation strategy in India.

g) **Salinity Management:** The metabolism of plants is negatively impacted by the accumulation of salts in the soil to an unhealthy degree. Salinity control is crucial because high salt levels may kill flora, which in turn leads to soil erosion.

h) **Terracing:** The practise of cultivating land on terraces, which has been levelled in advance, is one of the most effective soil protection techniques. The practise of terracing involves cultivating on a special step-like structure that reduces the likelihood of water runoff.

i) **Bordering from Indigenous Crops:** Although it is ideal to use native plant species, it is sometimes essential to surround non-native crops with native ones. This is a popular option in economically depressed rural communities since it helps to preserve soil quality.

j) **No-tilling Farming Method:** Tilling refers to the process of ploughing soil for agricultural purposes, during which nutrients are combined with the soil and planting rows are made. But this technique kills vital soil organisms, depletes organic matter, and compacts the soil. The no-tilling method is utilised to preserve soil health despite these drawbacks.

k) **Increased use of organic manure:** Indian farmers may prevent the loss of soil nutrients that occurs with continuous cropping by using a practise called manuring. Manures may come from either animal or plant waste. They guarantee the enhancement of soil production, another facet of soil conservation.

l) **Keeping the soil covered:** Compared to trees, grasses are a far more reliable soil protector.

m) **River embankments:** Soil erosion along riverbanks may be mitigated by the construction of embankments.

VEGETATION

India's gorgeous country is subject to a wide range of climatic conditions due to its tropical location. India's climate is conducive to forest expansion. However, the climate patterns of the nation have been drastically changed by human activity during the previous thousand years. Forests make up the bulk of India's natural vegetation.

The natural vegetation of an area is the plant life that has evolved there in response to the local climate and other factors. Soil, terrain, temperature, and rainfall are just a few of the primary variables that have had a significant impact on India's native flora and fauna. The natural vegetation of India may be categorised in several ways, depending on aspects including climate, topography, and altitude. Tropical deciduous forests, tropical rain forests, alpine and tundra vegetation, rain forests of Southern India, Himalayan vegetation, the desert area, temperature forests and grasslands, and many more are all elements that define the natural vegetation of India.

(A) MOIST TROPICAL FORESTS

The places with high temperatures and rainfall are home to these woods. The woods are thick and layered, with many different kinds of trees, shrubs, and lianas. There are four distinct varieties of these woods, each distinguished by the amount of moisture present and the species most often found there.

(1) **Tropical moist evergreen forests:** These woods are the climatic climax type and are typical of regions with annual rainfall of 250 cm or more and temperatures of 25-30 °C. The western sides of the Western Ghats, Assam, Cachar, sections of West Bengal, northern Canara, the Annamalai Hills, Coorg near Meysore, and the Andman Islands are where you'll find the most of these woods.

Trees in these woods often exceed 45 metres in height and develop in thick stands. Herbs and grasses are uncommon, whereas climbers, lianas, epiphytes, and shrubs abound.

Because the tree canopy is so thick, not enough light can get to the ground for the carpet layer of herbs and grasses to flourish.

Dominant trees in forests of west coast are *Dipterocarpus indica, Palaquim andCellenia*while in forests of Assam are Diptercarpusmacrocarpus, D. turbinatus,Shoreaassamica, Mesua ferrea and Kayea

(2) **Tropical moist semi-evergreen forests:** These woods are typical in regions with an annual rainfall of 200–250 cm and temperatures of 25–32°C, making them climatic climaxes. The Western Ghats, the higher regions of Assam and Orissa, and the Andman Islands are the primary locations of these forests. Northern India has a greater concentration of these forests than southern India does.

These woods are distinguished by a mixture of evergreen and deciduous trees, the latter of which lose their leaves during the short periods of relative dryness. Trees in these woods often stand between 25 and 35 metres tall, and bushes abound. Herbs, grasses, ferns, and orchids form a thick understory in forests.

Dominant trees in these forests are

*Dipterocarpus alatus, Hopea, Terminalia and Salmalia***in Andman Island;** Artocarpus,Micheliaand Mangifera **in Orissa;** Schimawallichii, Bauhinia, Phobe and Ammora in **Assam.**

(3) **Tropical moist deciduous forests:** Temperatures range from 25 to 30 degrees Celsius, and the region receives an average of 150 to 200 centimetres of precipitation per year, most of which falls in short, intermittent bursts throughout the year. Due to intense biotic forces, woods have been transformed into open savannahs in a number of locations. Forests like this may be found in the wet regions of Kerala, Karnataka, southern Madhya Pradesh, northern Uttar Pradesh, sections of Bihar, and West Bengal, and along the eastern edge of the Western Ghats and the Chota Nagpur and Khasi hills.

The deciduous trees, which lose their leaves for just a few weeks out of the year, are the most prominent feature of these woods.

In the north, Tectona grandis, Shorearobusta, Salmella, and Dalbergia are the dominant trees, whilst in the south, Tectona grandis and Shorea sp. are the most common.

(4) **Littoral and swamp forests:** Wet marshy environments, river deltas, salty or other swampy areas, and coastal locations are common places to find these woodlands. They are found mostly in the saline swamps of Sundarban in West Bengal, the coastal parts of Andhra Pradesh and Orissa, and in less saline or non-saline marshy pockets across the remainder of India (Tidal forests).

The halophytic evergreen plants, which can grow in salty conditions, are the primary feature of these woods.

Dominant plants of tidal and mangrove

Rhizophora, Bruguiera, Ceriops, Horitora, Avicennia, Nipa, Sonneratia, and Acanthus are all trees that thrive in woods. Ipomea, Phoenix, Phragmitis, Casuarina, Manilkara, and Calophyllum are some of the plants that thrive in less salty marshes. Barringtonia, Syzygium, Myristica, Bischofia, Trowia, Lagerstroemia, Sophora, Pandanus, Entada, and Premna are among the main species found in different types of marshes.

(B) DRY TROPICAL FORESTS

These woods are prevalent in regions that have a rainy season followed by a lengthy dry spell in which the trees stay bare. Smaller trees and shrubs predominate in these woods, along with an abundance of shrubs and even grasses in certain cases. There are three different kinds of forests in this group.

(1) **Tropical dry deciduous forests:** Temperatures of 25 to 32 degrees Celsius, annual precipitation of 75 to 125 centimetres, and a dry season of roughly six months characterise the environments in which these woods thrive. These woods may be found in the states of Punjab, Haryana, Uttar Pradesh, Bihar, and Orissa, all of which are located in northern India. These woods may be found in the arid regions of the Indian states of Maharashtra, Tamil Nadu, Karnataka, and Madhya Pradesh.

The woodlands are characterised by an open canopy of tiny trees (only 10-15 m in height) and an abundance of plants. Dominant species of the woods in northIndia include Shorearobusta, anogeissus,Terminalia, Buchnnania, Somocarpus,Carissa, Emblica, Madhuca, Acacia, Aegle, Diospyros, Bauhinia, Eugenia, Zyzyphus,Lannea, Sterculia, Dendrocalamus,Salmelia, Adina, Grewia, Adathoda andHelicteres. Most of the south Indian flora consists of Tectona grandis, Dalbergia, Kydia, Terminalia, Pterospermum, Dillenia,

Acacia, Diospyros, Anogeissus, Boswellia, Bauhinia, Chloroxylon, Hardwickia, Soymida, Gymnosporia, Zyzyphus, Dendrocalamus, and Holorrhena.

(2) **Tropical thorn forests:** High temperatures of 27-30°C and extremely low annual rainfall of 20-60 cm combined with lengthy spells of dryness are typical of the regions where these woods may be found. Western Rajasthan, as well as portions of Maharashtra, Madhya Pradesh, and Tamil Nadu, are home to these woods. Scrubs, rather than trees, predominate in these types of woods, which are characterised by a sparse distribution of tiny (8-10 m) primarily thorny trees. These woodlands are notable for their absence of greenery during much of the year. Only during the short wet season, when grasses and plants also flourish, can they produce leaves.

Dominant plants in these forests are Acacianilotica, Albizzia, Capparis, Prosopis, Albizzia senegal, Prosopis spicigera, Prosopis juliflora, and A. leucophloea.

(3) **Tropical dry evergreen forests:** These woods are prevalent in regions that have little precipitation outside of the summer months. Some regions of Tamil Nadu and Karnataka are home to woods.

The woods are characterised by the lack of bamboo and the abundance of grasses, as well as by the dense distribution of mixed small evergreen and deciduous trees of 10-15 mheight.

Memecylon, Maba, Pavetta, Foronia, Terminalia, Ixora, Sterculia, Mesua, and Schleichora are some of the most common plants found in woodlands.

(C) MONTANE SUBTROPICAL FORESTS

These woods are found on the slopes of mountains between 1,000 and 2,000 metres in height, where the weather is milder

than in the tropics but warmer than the temperate zone. Semi-xerophytic evergreen plants predominate in the woodlands. There are three different kinds of forests in this group.

(1) **Sub-tropical broad-leaved hill forests:**

These woods are often found in lower, wetter parts of mountain ranges. They are found mostly in the Khasi, Nilgiri, and Mahabaleshwar hills, as well as the eastern Himalayas of West Bengal and Assam. Evergreen broad-leaved trees dominate the landscape, and many climbers, epiphytic ferns, and orchids thrive among them.

Dominant trees in the forests of north are

*Quercus, Schima*and *Castanopsis*with sometemperate species. **In the southern areas,dominants are** *Eugenia* and members of family Lauraceae.

(2) **Sub-tropical dry evergreen forests:** These woods are found in regions with low average temperatures and precipitation. The lower elevations of the eastern and western Himalayas are where you'll find these woods.

The presence of prickly xerophytes and small-leaved evergreens is the most defining feature of the woodlands. Acacia modesta, Dodoneaviscosa, and Olea cuspidata are the most common tree and shrub species found in these woods.

(3) **Sub-tropical pine forests:** These woods may be found in the Himalayas at elevations between 1,500 and 2,000 metres. They may be found from Kashmir to Uttar Pradesh in the western Himalayas. The woods of the Khasi Jayantia Hills in Assam may be found in the eastern Himalayas. Pine trees grow in wide groups that are a defining feature of the woodlands.

P. roxburghii and Pinus khasiana are the most common tree species in the woodlands.

D) TEMPERATE FORESTS

These woods are located in regions with low temperatures and more humidity than those found in higher latitudes. Greater rainfall in the Himalayas is to blame for the region's high humidity, with the exception of certain regions in Uttar Pradesh, Punjab, Himachal Pradesh, and Kashmir. Most of these woods may be found between 2,000 and 4,000 metres in the Himalayas. Epiphytic mosses, lichens, and ferns abound on the towering conifers and angiospermic evergreen trees that often dominate the woodlands. There are three distinct forest types represented here.

(1) **Wet temperate forests:** These woods are located in the colder and more humid highlands, at elevations of 1800–3000 m. They may be found in the Nilgiri Hills of southern India, the western Himalayas from Kashmir to western Nepal, and the eastern Himalayas from eastern Nepal to Assam.

Evergreen, semievergreen, broad-leaved, and coniferous trees, some as tall as 25 metres, create thick formations in the Himalayan woods. These woods, known as Shola forests in southern India, are characterised by a thick leaf canopy of 15-20 m tall broad-leaved trees, an abundance of epiphytic flora, and a lush herbaceous undergrowth.

Quercus, Betula, Acer, Ulmus, Populus, Corylus, Caprinus, etc. are only some of the angiosperms that thrive in the western Himalayan woods, along with conifers like Abies, Picea, Cedrus, etc.

(2) **Himalayan moist temperate forests:** The eastern and western Himalayas are home to these woods between an elevation of 1700 and 3500 metres. These regions have an

annual rainfall of more than 100 centimetres, but less than those of moist temperate woods.

The towering (up to 45 m) conifers, oaks, or their combination, and the sparse, partially deciduous undergrowth are the woods' defining features.

Tree species such as Tsuga dumosa, Quercus lineata, Piceaspinulosa, Abies densa, and Quercus pachyphylla predominate in the eastern Himalayas. Upper Himalayan zones are dominated by Quercus semicarpifolia and Abies pindrew, while lower Himalayan zones are home to Quercus incana, dialata, Cedrus deodara, Pinus wallichiana, Picea smithiana, Abies pindrew, Cotoneaster, Berberis, and Spire.

(3) **Himalayan dry temperate forests:** Low-rainfall Himalayan areas are home to these woodlands. They may be found on both the western and eastern sides of the Himalayas. The woodlands are most recognisable for the preponderance of evergreen oaks and conifers. Scrubs create the understory.

Pinus gerardianaandQuercus ilexare the most common tree species in the western Himalayas' forests due to the region's relative lack of moisture. Abies, Picea, Larix griffithii, and Juniperus wallichiana predominate in the western Himalayas due to the region's higher average precipitation.

(E) ALPINE FORESTS

The Himalayas are home to some of the world's coldest and driest forests. Herbs and grasses, both permanent and annual, dominate the woodlands, however trees may thrive in the moister regions. Lichen flowers bloom profusely in these woods, making them instantly recognisable. There are three different kinds of forests in this group. To begin, let's talk about (1) sub-

alpine woods. These woods occur in thin bands from around 3,500 metres up to the tree line in the Himalayas.

The predominant shrub layer and the presence of certain evergreen conifers are the most distinctive features of these forests. Abiesspectabilis, Rhododendron, and Betula are the most common trees found in the woodlands. Cotoneaster rosae, Smilax spp., Lonicera spp., and Strobilanthus spp. all make notable appearances in the woodlands.

(2) **Moist alpine scrub forests:** Above the tree line in the Himalayas, up to around 5,500 metres, you'll find these woodlands.

Dwarf, evergreen shrubbyconifers and broad-leaved trees predominate in these woods, together with a noticeable shrub layer underneath them.

Juniperus and Rhododendron are the most common species of trees there.

(3) Dry alpine forests: These woods thrive at higher, drier altitudes in the Himalayas, up to around 5,500 metres. The open creation of xerophytic scrubs consisting of various plants and grasses is the most defining feature of the woods. The Juniperus, Caragana, Eurctia, Salix, and Myricaria species predominate in the woods.

Distribution of forest by States/Union Territories

The 2019 Forest Survey found that Madhya Pradesh has the highest percentage of forest cover of any state in India. Mizoram has the highest proportion of forest cover (85.41%) of any state. Lakshadweep is home to a forest cover of almost 90.33 percent. [9] Karnataka has had the most rise in forest cover among the States/Union Territories, followed by Andhra Pradesh, Kerala, and Jammu & Kashmir, while Manipur, Arunachal Pradesh, and Mizoram have seen the greatest decrease.[21]

2015 forest survey data

According to the results of the 2015 forest census, which were collected and released by the Government of India, the following five states have the most percentage of their land covered by trees:[22]

State	Area (in square kilometres)
Madhya Pradesh	77,462
Arunachal Pradesh	67,248
Chhattisgarh	55,586
Maharashtra	50,628
Odisha	50,354

2019 forest survey data

Government of India's 2019 forest census data reveals the following five states have the most forested land area.:[24]

Percentage of Forest cover map as of 2021

State	Area (in square kilometres)
Madhya Pradesh	77,482
Arunachal Pradesh	66,688
Chhattisgarh	55,611
Odisha	51,619

Maharashtra	50,778

Conservation

The 1988 National Forest Policy further highlighted the importance of forests to the national economy and ecology by working to restore ecological balance and preserve the remaining forest cover. The strategy also sought to include local people in the management of forest resources while supplying rural and tribal communities with fuelwood, food, and small timber.Also in 1988, the Forest Conservation Act, 1980[32] was amended to facilitate stricter conservation measures. India's forest cover was formerly estimated at 23%, but a new goal set for itself was 33%. Forest science and social forestry, or incorporating local people's cultural practises and values, were brought together in official government decisions in June 1990. Nearly 179,000 square kilometres of land were planted with trees between 1951 and 1991. Despite widespread efforts to reforest the country, India's forest cover has shrunk since the country's independence. One key factor is annual cutting at a pace about four times the growth rate. Another big detriment is the rampant theft of firewood and fodder by local locals. Land clearing for agricultural and development programmes is also a contributing factor, as highlighted in the National Forest Policy of 1988.

The rate of deforestation in India has decreased since 1990. In 2010, FAO found that India was growing its forest cover at the third-fastest rate in the world.[33] A NASA research from 2019 found that India and China have contributed the most to global vegetation growth over the previous two decades.[34][35]

The paper outlining India's national forest strategy from 2009 stresses the need of integrating forest conservation with sustainable forest management.[33] India considers sustainable forest management to be one in which national economic demands and local concerns are addressed via scientific forestry practises without sacrificing the economic needs of local populations.[26]

4.95% of the area of India (156,700 km^2) called Protected areas of India is reserved for the in situ conservation of species and their natural habitat.

SOCIAL FORESTRY

The number of people living in India is now more than one billion. The amount of farmland available per person has decreased dramatically. If deforestation continues at its current pace, there will be almost no forest left in the world over the next fifty years. Fuel wood and animal feed are in very limited supply as it is. Increases in fuel wood output are needed even only to meet current demand. The impoverished are in an increasingly vulnerable position. Women must trek long distances to get firewood, feed, and water. Millions of forest-dependent people have seen their economies and way of life utterly destroyed by the scarcity of forest-based basic supplies. India's future depends on the restoration of its damaged forests and other types of cultivable and non-cultivable land. The rapid increase in the population is one of the greatest dangers facing the nation right now. While food grain production has kept pace with population growth in recent years, feeding the world's population of 9 billion in the next century remains our greatest problem. Unfortunately, the incorrect and excessive use of chemical inputs in our efforts to keep up with rising demand has severely damaged our planet's agroecosystems. The land's condition has worsened because of the increasing demands placed on it by the country's human and livestock populations. A more scientific approach is required for the use of these lands, frequently referred to as degraded or waste-lands, since they are progressively becoming less usable as a result of soilerosion, injudicious use of chemical fertilisers, water logging, salinity/alkalinity, shifting agriculture, etc. Wasteland usage has

emerged as a key component of sustainable development thanks to the increased global attention on environmental protection and the notion of sustainability.

Why Social Forestry?

Sustainable development toolsets include social forestry. This is because it has the capacity to address all three of the fundamental problems facing the rural poor at the same time. Sustainable development may be achieved by its ability to offer food security, fuel security, and livelihood security while also being environmentally responsible. Forests are very important since they provide essential materials for a variety of industries and essential medicines and treatments. The strain on forest resources to meet the rising demand has grown considerably more severe in light of the many developmental programmes. Consequently, there is a widening gulf between supply and demand. Growing trees on all publicly and privately owned property is necessary to close this gap. Vegetational imbalances in different areas may be mitigated thanks to the work of social foresters. Since there is no way to increase the total forest area, we must resort to converting as much private property as possible into woods. That's why it's clear we need a serious social forestry initiative.

Government for social forestry

The National Commission on Agriculture reviewed the forestry industry in 1976 and made two recommendations based on their findings. Increased focus on production forestry via the creation of Forest Development Corporations and a Social Forestry programmed focused on meeting the primary needs of rural communities' fuelwood and fodder shortages.

It was intended that social forestry be a people-driven initiative. Given the labor-intensive nature of social forestry, it was thought that it would have a major impact on rural employment. Social forestry, with itsvillage woodlots, farm forestry and other afforestationactivities looked to promise the greeningof the land. In the long term, this might have prevented further forest loss and helped the country's ecosystem recover.

From the Sixth Plan forward, the government committed major resources to social forestry and ensured its continuation and development.

Fuel-wood deficient areas were willing to embrace centrally supported plans to increase fuel-wood availability. Global organisations provided substantial funding for social forestry projects, which sought to empower rural residents by putting them in charge of fuel-wood and fodder production. The National Commissionon Agriculture (1976) outlined the goals of social forestry, and these include:

(1) fuelwood supply to replace cowdung
(2) small timber supply
(3) fodder supply
(4) protection of agricultural fields againstwinds, and
(5) recreational needs

Local Organization efforts

The potential of social forestry relies heavily on the efforts of locally organised groups. After thoroughly assessing the community's requirements, nonprofits may implement a prototype. In order to satisfy demands, they must determine which locations and species are suited to certain types of terrain. Association of the people is crucial to the success of the programmes. Participation of the people in the development,

implementation, and administration of their own resources is essential. Creating a village council charged with organising and carrying out community-wide initiatives is one solution to this problem. Volunteer organisations excel at grass-roots level planning. The support of the local community lends credence to their claims. It's important for a community to have a strong leader who can rally the villagers together.

Local agencies' primary responsibilities in the forest development cause are forest regeneration and tribal community revitalization. There is tremendous diversity within the nonprofit industry. A number of nonprofits see afforestation as a way to make money, while others see it as an opportunity to improve the environment or strengthen local communities. Therefore, the strategy used by local agencies is equally crucial to the outcome. The village panchayats in West Bengal played a key role in determining who should get land grants, which contributed to the program's overall success. Village panchayats in West Bengal were revitalised when land reforms were enacted and excess lands were redistributed. Successful forest conservation efforts by rural communities have prompted the West Bengal government to roll out the programme statewide. It is difficult to acquire widespread engagement and interest without a local organisation. The notion of equality in distribution of local resources has been crucial to the success of many afforestation and sustainable use of forest initiatives. The ladies of Chipko, a Himalayan hamlet, have banded together to protect the area's ecosystems and expand the community's access to fuelwood and feed. In order to avoid landslides, they planted on the most vulnerable slopes. The Sukhomajri initiative in the Shivalik hills is another thriving community organisation based on fair

distribution of goods. The Sukhomajri village has been able to protect its watershed, save the village from falling into a widening gorge because of massive erosion and has been able to increase the social and economic well-being of the village community in a span of three to four years. The Water Users Association that Sukhomajri set up uses a tiny dam to collect rainwater and distribute it fairly to its members. Everyone has a right to an equal portion, which may be traded for cash, land, or other goods and services". Every resident of the hamlet has an interest in preserving the watershed to prevent silting of the dam. The Forestry Department attempted to plant trees in the watershed to reduce soil erosion, but the locals did not help. Villagers were threatened with arrest and penalties by forest authorities if their livestock were found grazing in the watershed. However, we know from other places' experiences that these processes don't work. Only when the community established its own organisation and assured equitable distribution of benefits that every member of the community endeavored to safeguard the afforestation in the watershed. With the building of the check-dam, with availability of harvested rain-water, with the consensus on equitable sharing of water, the economy of the village boomed.

Selecting suitable Species

The right species, adapted to the land's potential and environmental circumstances, must be identified if the demands are to be met. Non-profit organisations have the option of choosing species that will best provide the regional need for food, shelter, and energy. It is fairly uncommon for consumers to choose inferior firewood kinds despite a scarcity. The farmers' worry that they won't make a profit may be to blame. A fast-

growing native tree with several uses would be very valuable. Farmers are facing a severe crisis due to a lack of feed. Therefore, the forage species should be treated with the respect they deserve.

An person may satisfy his needs by planting any combination of the following species: Artocarpus for fruit, firewood, and foldder; Tectona grandis for lumber; Eucalyptus, Neem, etc. for medicinal value; bamboo for timber; etc.

Barriers blocking the Success

There has been progress in the right direction, but in order to speed up social forestry even more, it is necessary to pinpoint the primary obstacles holding it back. They may be summarised as follows based on many research and reports:

1) A closer look at the goals and results of social forestry reveals a focus on tree plantations that are primarily used for fodder and fuel wood, which has a negligible impact on the quality of life for low-income households. Therefore, there has been no appreciable decrease in the demand for forest land. Much less acreage has been used for block planting on degraded waste land than for strip plantation.

2) The decision regarding the plantation reflects the fact that bureaucratic and departmental imperatives are more strong than the interests of disadvantaged people. Therefore, more unsuccessful initiatives that individuals would be ready to invest in with government assistance.

3) Ever-increasing aims and complicated and intensive management leave little room for expansion or seeking the 'participation,' which remains 'an ideology without a methodolgy,' as noted in an assessment study of social forestry.'

4) The forestry industry, which is responsible for species selection and spacing, prioritises plants that will generate money and plants that are ecologically important above plants that would meet the immediate requirements of the population. The demands of one generation are disregarded in favour of those of the next. It was not understood that animals that produced intermediate goods may help the impoverished. Grass, legume, fodder, fruit, and small forest product production are so ignored.
5) The structure of marketing arrangements and pricing of minor forest produce are totally ignored in comparison to production efforts under the social forestry programmes. Forest co-operatives which had once played very significant role have almost disappeared now.
6) People's involvement in social forestry initiatives is quite low. Workers involved in a project's execution use various approaches. The idea that I manage, you participate should be the guiding premise of government programmes has been widely accepted. In contrast, the FAO defines participation as the process by which the ruralpeople are able to organise themselves andthrough their own organisation are able to identify their needs, partake in design, execution, and assessment of the participatoryaction.
7) In addition to encouraging individuals to become involved in social forestry, NGOs play a crucial role in improving previously unforested land via it. Specific criteria for the involvement of NGOs have been prepared by the National Waste Land Development Board. However, the department's most recent project report, Integrated Forest Development, contains disheartening comments on the effectiveness of NGOs.

8) Despite the widespread acknowledgement of trees as a convenient savings account, few small and marginal farmers actually invest in tree planting. Security, ownership, price, marketing, and even perks all play a role in the dismal reaction.
9) It's worth noting that anti-poverty employment programmes include objective provisions for covering forest development labour, activities that might be readily tied up with social forestry initiatives. Due to a lack of coordination among government agencies, such connections do not exist. Thus, a thorough examination of existing social forestry programmes allows us to zero in on key concerns and give them a boost in the right direction, thanks to the assistance of concerned citizens and public and private sector groups alike.

Suggested Policy Actions

It's not simple to come up with concrete and practical policy recommendations. Smaller efforts might be made to highlight major policy shifts, however:

A) To help the underprivileged, we need to take concrete action. Now that forest workers have a positive reputation because to social forestry initiatives, they can more easily communicate with locals via groups like Panchayats and NGOs.

B) Raising awareness about the value of current social forestry initiatives. But it also has to be a one facility centre where individuals can go to get everything they need to start practising social forestry.

C) Not only has the department recognised the Aghakhan Rural Development support Programme (AKRSO) as a role model for NGO engagement, but it has also provided insight into how to address afforestration by employing formerly homeless people

as landless labourers. It could be possible to try to recreate these models.

D) The requirements of the poor and the community and economy at large may be balanced if the program's decision-making process is substantially decentralised with enough involvement of the beneficiaries. This is the only path that will allow us to strike a balance between environmental preservation and economic development.

School Nursery Programme

The creation of nurseries is the primary focus of the social forestry initiative. The nurseries should be conveniently located for the farmers; in other words, decentralised nurseries should be set up to increase people's motivation to plant trees. In the Chitradurga district of Karnataka, the Tarabalu Rural Development Foundation has established a model nursery programme. Its 157 educational institutions are an invaluable tool for social change and growth. In 1985, the organisation began working with the Social Forestry Department of Karnataka and the Society for the Promotion of Wasteland Development on a project called Tarabalu Seedlings (TS). The goals include establishing scientific afforestation of degraded land and launching social forestry, as well as the establishment of experimental nurseries in 60 schools engaging students and instructors.

Both kids and educators have positively responded to the School Nursery Development Programme. Seedlings are also available from kisan nurseries established by the Social Forestry Department of Karnataka. However, the community atmosphere at TS makes individuals interested in purchasing seedlings there. They imagine that their own kids grew the seeds. For this reason,

they favour these seedlings above those provided by Kisan nurseries. If social forestry is to become a mainstream movement, it must first establish itself in the hearts and minds of ordinary citizens, not simply foresters and government officials. School children's eating habits must be front and centre in the School Nursery Development Programme.

Tree Patta Scheme

The National Wastelands Development Board (NWDB) and the Ministry of Rural Development collaborated to design a tree patta programme as part of social forestry and rural development. The plan revolved on using access to public property for reforestation projects. The owner of the patta was granted usurer rights to the trees and grasses that grew there. The primary reason the plan did not take off was a lack of suitable land. The property on offer was very rocky and deteriorated, and acquiring it presented a number of political and logistical challenges. About 35–40 million hectares (ma) of treeless forest land is to be protected and cannot be utilised for afforestation under the direction of the Forestry Department. Social forestry and other afforestation projects are doomed to fail in the absence of access to land.

AGRO CLIMATIC REGIONS

Introduction

Agriculture has always been and will likely always be the primary means of subsistence for the vast majority of people. For decades, India's agricultural policy has prioritised the country's ability to provide for itself in terms of food supply. Significant advancements have been achieved in this area. From 51 million tonnes in 1951–52 to 244.78 million tonnes in 2010–11, food grain output increased steadily. Due to its slower growth rate compared to industry and services, agriculture's contribution to real GDP has decreased. But what's worrying is that agricultural growth has often lagged below Plan projections. Foodgrains output increased at a CAGR of almost 2% between 1960–61 and 2010–11. In fact, compared to the 4.72 percent growth rate seen in the Eighth Five Year Plan, the agricultural sector grew at a rate of 2.44 percent and 2.30 percent during the Ninth and Tenth Five Year Plans, respectively. The agricultural sector is expected to increase by 3.28 percent over the XI Five Year plan, which is below the 4 percent goal set for the period.

India has the greatest cow population and produces the most milk, cashew nuts, coconuts, tea, ginger, turmeric, and black pepper (281 million).

Wheat, rice, sugar, groundnuts, and inland fish are all produced in second-largest quantities there. It's the third biggest tobacco producer in the world. India produces the most bananas and sapota in the world, and its total share of global fruit output is 10%. India's rising population is outpacing the country's capacity to increase its grain harvest.

Agro Climatic regions

- Because of its impact on crop ecology and the resulting regional differences in agriculture, climate is one of the most influential variables in shaping the agricultural landscape of any given area.
- Calendars, agricultural yield, and cropping patterns vary throughout the nation as a result of varying meteorological conditions.
    - In 1989, the Planning Commission of India and the National Remote Sensing Agency worked together to split the country into Agro-climatic areas based on factors including soil type, rainfall, temperature, and available water.
    - The relative demand on land and environmental elements have been taken into account while creating the typology required to designate the zones, in addition to resource concerns and land productivity level.

India has been divided into 15 major agro-climatic regions, as follows:

1.
1. **The Western Himalayas**
    - Jammu and Kashmir, Himachal Pradesh, and Uttarakhand are all included in this area.

- It has a very diverse landscape, including high mountains, low valleys, and steep slopes.
- Temperatures in the area range from 5 to 300 degrees Celsius in the summer to -40 degrees Celsius in the winter.
- The average annual precipitation is between 75 and 150 cm, with the exception of Ladakh, where it is less than 30 cm.
- The Area Several perennial rivers drain the area.
- Crops like as rice, corn, wheat, barley, and vegetables are cultivated in the terraced fields that dot the hillside.
- Fruits including apples, pears, almonds, and walnuts thrive in the region's moderate climate.
- Gujjar and Gaddi shepherds raise sheep and other animals on dhoks/margs, the alpine meadows found at elevations over 2,000 metres.

1.
2. **The Western Himalaya**

- Sikkim, the Darjeeling hills of West Bengal, the Assam Hills, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, and Meghalaya make up the eastern Himalayan region.
- It has a mountainous landscape with steep inclines, dense woods, and rushing rivers.
- Precipitation averages around 200cm per year, making the climate sub-humid.
- Temperatures range from 30 to 10 degrees Celsius in July and January, respectively.

- The soil is reddish-brown and rather barren.
- The percentage of land used for shifting agriculture is around one-third.
- Main crops include rice, maize, potatoes, and fruits.
- Tea plants are often planted on the steep sides of hills.
- Typical regional concerns
- The degradation of forest and soil resources due to changes in agricultural practises.
- Erosion of hillside soil
- This highlights the need of controlling soil erosion by halting surface run-off.
- Farmers in the area might benefit from a boost in revenue from supplementary businesses like sericulture, poultry farming, etc.

1.
3. **The lower Gangetic plains**

- This area includes the states of Bihar and West Bengal to the east, and the Brahmaputra Valley in Assam to the north.
- It consists of fertile alluvial soil that rivers have deposited.
- Oxbow lakes and a very mild slope define the region.
- The terrain is prone to waterlogging, and marshy regions may be found all throughout, since the average annual rainfall is between 100 and 200

cm and the average annual temperature is between 12 and 300 C.

- Irrigation is mostly provided by means of wells and canals.
- The weather is perfect for growing rice and jute.
- As a result of the changes brought about by the Green Revolution, wheat is now widely grown as a winter crop.
- Other significant crops include maize, legumes, and potatoes.
- Improving rice cultivation, horticulture, pisciculture, and animal production are crucial to the region's progress.

1.
4. **The middle Gangetic Plains**

- It encompasses the whole of Bihar and the eastern portion of UttarPradesh.
- It's a gently sloping plain where the Ganga River has deposited rich alluvial material.
- Temperatures are at 10–400 degrees Celsius, and yearly precipitation averages 100–150 cm in this region.
- Kharif crops mostly consist of rice, maize, and millets, whereas Rabi crops primarily consist of wheat, gramme, barley, peas, mustard, and potatoes.
- Main fruit crops include mango, guava, lichi, and banana.

- The potential for raising a better Kharif paddy crop in this area is enormous.
- Farmer revenue may be bolstered by diversification into industries including dairying, timber harvesting, and agroforestry.

1.
5. **The Upper Gangetic plains**

- This includes parts of western Uttar Pradesh, the Rohilkhand region, the Lucknow division, and Uttarakhand.
- Sub-humid continental climate, with annual precipitation between 75 and 150 cm and temperatures between 10 and 400 C may be found here.
- The infrastructure for canal and tube well irrigation in the region is complete.
- Wheat, rice, sugarcane, millets, maize, pulses, gramme, barley, oilseeds, and cotton are commonly farmed in this area due to the region's high agricultural activity.
- The Green Revolution has benefited this region as well.
- Mixed cropping, horticulture, floriculture, and the amelioration of salt-affected soils are all part of the regional improvement plan.

1.
6. **The Trans-Ganga plain**

- Punjab, Haryana, Delhi, Chandigarh, and a portion of Rajasthan all make up this plain.
- The semi-arid environment, with annual rainfall ranging from 40 to 100 centimetres, makes for fertile alluvial soil in the area.
- The winter season receives the majority of its precipitation from the South-West Monsoon, while the remainder comes from the Western Disturbances.
- The region has a continental climate, therefore temperatures swing wildly from summer highs of 450 C to winter lows of 100 C.
- Canal and tubewell irrigation are possible thanks to a perennial river.
- Wheat, rice, sugarcane, maize, cotton, and pulses are some of the most heavily farmed crops in this area.
- In the 1960s, HYV wheat and rice seeds were introduced to the region, marking the beginning of India's Green Revolution. However, since then, the area has seen severe waterlogging, salinity, alkalinity, and soil degradation as a result of excessive irrigation.
- Due to excessive pumping, the region is also seeing a catastrophic drop in its water table.

1.
7. **The Eastern Plateaus and Hills**

- The Chotanagpur plateau, Rajmahal Hills, and Chhattisgarh lowlands are also a part of this area.

- There are areas of laterites and alluviums among the red and yellow soils.
- Surface water is scarce because of seasonal streams and ground water is scarce because of hard, impermeable rocks. The annual precipitation ranges from 75 to 150 centimetres, while the temperature ranges from 10 to 400 degrees Celsius.
- Rainfall provides the majority of the water needed for the region's rice, maize, millet, ragi, gramme, oilseed, tobacco, and potato crops.
- Water harvesting, water shed construction, oil and pulse cultivation, and HYV seed introduction are all places where progress may be made.

1.
8. **The central plateaus and Hills**

- Bundelkhand, Baghelkhand, the Malwa Plateau, and the Vindhyanchal hills are all a part of this area, which spans the eastern portion of Madhya Pradesh and some of neighbouring Rajasthan.
- Semi-arid climates prevail in the area, with annual precipitation ranging from 50 to 100 cm and temperatures from 10 to 40 C.
- Soil colours range from red to yellow to black.
- Produced here includes millets, wheat, grammes, pulses, oilseeds, cotton, and sunflower.
- Due of water shortages, water-saving equipment like sprinklers and drip systems are essential in this area.

- Dry farming, crop diversification, expanding the dairy industry, and raising poultry are alternatives.

1. 9. **The Western Plateaus and Hills**

- The area encompasses southern Maharashtra's Deccan plateau and Malwa's southern end.
- Known as regur, this area is characterised by its dark dirt.
- The average annual rainfall in the area is between 25 and 75cm, making it semi-arid.
- The region's irrigation infrastructure is woefully insufficient, serving just around 13% of cultivated land.
- thus, agriculture is both rain-dependent and drought-tolerant.
- The most important crops are jowar, cotton, sugarcane, rice, bajra, wheat, gramme, and legumes.
- By using water-saving tools like sprinklers, farmers in the area may boost agricultural output.

1. 10. **The Southern Plateaus and Hills**

- The states of Andhra Pradesh, Telangana, northern Tamil Nadu, and southern Maharashtra are all a part of this region.
- Semi-arid conditions prevail in the region, with annual precipitation averaging 50–100 cm and temperatures ranging from 13–400 °C.

- Due to the lack of precipitation and the constant warmth, this region is mostly used for dry farming, producing foods such millets, pulses, oilseeds, coffee, tea, and cardamom.
- A better future is possible if the area invests in poultry, dairy farming, horticulture, and water-saving technologies.

1.
11. **The East Coastal Plains and Hills**

- From Odisha to Kanniyakumari, the area stretches along the whole eastern coast.
- Northern Circar describes the northern section of this area, whereas Coromandel coast describes the southern half.
- Deltas are the most distinctive feature of this area since they are generated by the depositional processes of the Mahanadi, Godavari, Kaveri, and Krishna rivers.
- The average annual precipitation is between 75 and 150 cm, making the climate sub-humic marine.
- Because of is proximity to the ocean, the temperature range is just 20–300 C.
- Alkalinity is a major issue in the region's alluvial, loamy, and clay soils.
- Rice, jute, tobacco, sugarcane, maize, millets, pulses, groundnuts, and oilseeds are the primary agricultural products.

- Strategies for agricultural growth include lowering support for rice monoculture and raising support for crop diversity.

1. **The Western Coastal Plains and Western Ghats**

- Including the coasts of Maharashtra, Karnataka, and Kerala, the territory stretches from the northernmost tip of the Tapi Estuary to the southernmost tip of Kanniyakumari.
- Konkan Peninsula in the north, Malabar Peninsula in the south.
- Over 200cm of rain falls annually, and temperatures average between 18 and 320 °C.
- Common agricultural products include rice, coconut, oilseeds, sugarcane, millets, lentils, and cotton.
- Increased cultivation of high-value crops like spices, legumes, and fruits is one development strategy.
- Drainage repairs, infrastructure upgrades, and a push for prawn farming in brackish water are all possibilities.

1. **The Gujarat plains and Hills**

- Kathiawar's rolling hills and lowlands, as well as the river basins of the Mahi and Sabarmati, make up this area.

- Average annual rainfall is between 50 and 100 cm, and temperatures vary from 15 to 420 C; this is an arid and semi-arid terrain.
- The soils on the plateau are regur, whereas those in the coastal lowlands are alluvial.
- Among the most common crops are groundnuts, cotton, rice, millets, oilseeds, wheat, and tobacco.
- In irrigated parts of the region, wheat is the primary rabi crop.
- The whole area is well-known for its oil-seed harvests.
- Strategies for regional development include coastal and delta fisheries development, agroforestry, dry land farming, rain water collection, and surface and ground water management.

1.
14. **The Western Dry region**

- This area covers the westernmost portion of Rajasthan (west of the Aravalli range)
- It is a dry area with an average annual rainfall of less than 25 centimetres.
- Extreme temperatures of -50 C in winter and +400 C in summer are possible.
- It is mostly a sandy desert.
- Bajra and jowar are the primary Kharif crops, while wheat and gramme are cultivated during the Rabi season.

- The irrigation provided by the Indira Gandhi Canal has resulted in a shift in agricultural practises and an increase in farmer revenue.
- Improvements in crop quality and water management are two of the primary areas of focus in development plans.

1.
15. **The Island region**

- Both the Lakshadweep Islands in the Indian Ocean and the Andaman and Nicobar Islands in the Bay of Bengal are part of this area.
- The typical annual temperature is about 300 degrees Celsius, while the average rainfall is around 200 centimetres.
- Along the shore, the soil is sandy, while inland it ranges from sandy loam to clayey loam.
- Plantation crops like arecanuts, cassava, turmeric, etc., complement the more traditional crops like rice and corn.
- Coconuts take up about half of the cultivated land.
- Agriculture, water resources management, and fisheries should be at the forefront of any growth plans.

DRY ZONE FARMING

Agricultural ecosystems in dry areas are often unstable, hazardous, and inefficient. This affects all of the country's regions when the average annual rainfall is below 75 centimetres. About 22% of the nation is made up of dry land. A large portion of the states of Rajasthan and Gujarat are classified as dry lands, as are portions of the states of Punjab, Haryana, Maharashtra, Andhra Pradesh, and Karnataka. Low productivity causes it to focus on producing jowar, bajra, maize, cotton, groundnut, pulses, and oilseeds.

Problems of dry zone agriculture:

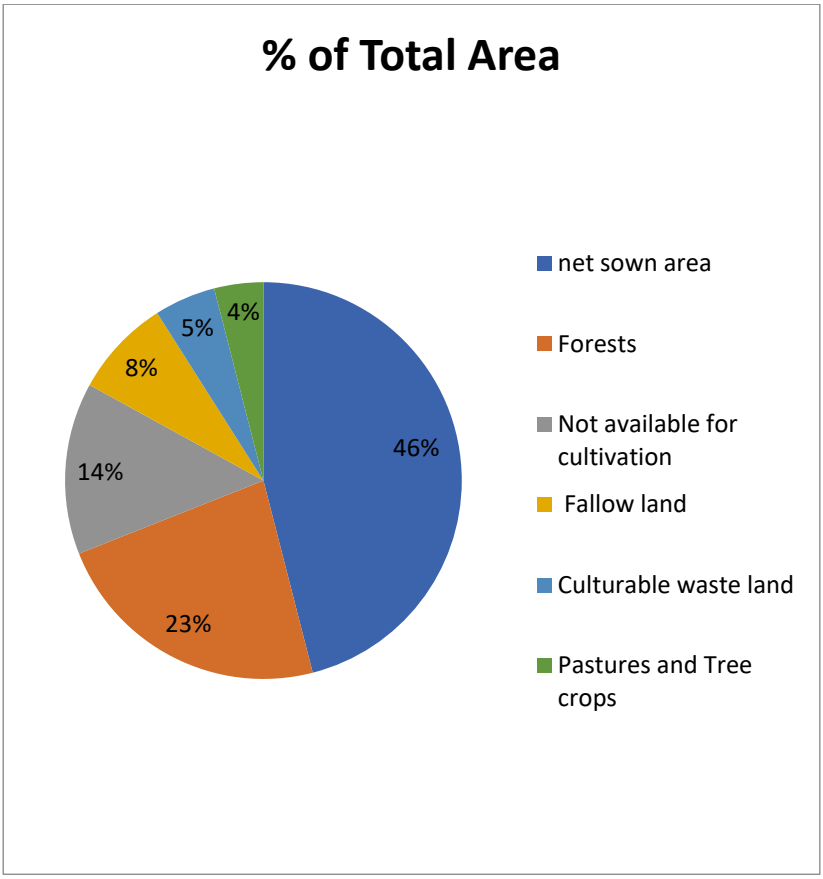
- Droughts and famines are commonplace in this area due to the inconsistency and scarcity of rainfall.
- This area's soil is sandy and deficient in the nutrients necessary to promote plant growth.
- Soil erosion is a major issue in this region.
- Reduced production and increased vulnerability to pests and illness
- There is a lack of organisation in the fields and the utilisation of modern farming equipment.
- These regions often suffer from a lack of basic infrastructure including roads, stores, and markets.

The time has come to initiate a second green revolution focused on coarse grains and oilseeds, one that uses organic farming practises to ameliorate the problems caused by the previous green revolution's widespread adoption.

India's land area is around 1.3 million square miles. These supplies may be broken down into three main types of aid:

Major land forms of India		
1.	Plain	43%
2.	Mountain &hills	30%
3.	Plateau	27%

Physical elements such as terrain, soil, and climate are important, but so are human ones including population density, length of habitation, land ownership, and technological sophistication. The country's use of its land resources may be shown as



Net sown Area

Net cultivated area and fallow areas are considered part of the total agricultural land definition. Net sown area refers to the total area that was planted in a crop in the current year. Because of how important arable land is to the agricultural economy, this region is of particular importance in a nation like India.

When compared to the global average of roughly 32%, India's net sown area in 2011 was about 46.05 percent of the total reported area.

In terms of overall land area, India ranks eighth, but in terms of arable land, it ranks second.

The ratio of net sown area to total area varies widely from one state to another.

With a total of 18.35 million hectares, Rajasthan's net sown area is far and by the biggest in the country.

Net sown area as a percentage of total reported area varies widely across states. With 82.6 and 80.5%, respectively, Punjb and Haryana had the highest percentages, while Arunachal Pradesh had the lowest (3.2 percent)

Forest Area

All land that is designated as forest or that is kept in a prospective forest land status is included in the definition of land under forest. The areas that are used for growing crops inside the forest and for grazing animals within the forest continue to have a forest cover over them. The whole land that is classified as forest in India accounts for 23 percent of the total. This is not enough for a tropical nation like India, for example. It is recommended that one third of the land area in the nation be covered with trees.

The state of Madhya Pradesh has the most land covered in forest, with 76,000 square kilometres of land, followed by the states of Arunachal Pradesh (68,000 square kilometres), Chhattisgarh (56,000 square kilometres), and Maharashtra (47,000 square kilometres). In terms of the proportion of land covered by forests to the total land area, the state of Mizoram has the greatest

proportion, at 88 percent, followed by Nagaland (82 percent), and Arunachal Pradesh (80 percent) (80 percent).

Geographical Distribution of Forest

Sl. No	Region	Percentage of total forest in India
1	Himalayas	18
2	Great Plains	5
3	Peninsular plateau and hills	57
4	Western Ghat and western coastal plain	10
5	Eastern Ghat and Eastern Coastal plain	10
	total	100

Culturable Waste

The term cultivable waste refers to land that is capable of being cultivated but is not being utilised for agriculture for one reason or another. This property has a history of human habitation but is now unoccupied for unknown reasons. At the moment, it is not being used for a variety of reasons including a scarcity of

water, the salinity or alkalinity of the soil, waterlogging, and other similar issues.

In the fiscal year 2010–2011, it was anticipated that culturable wasteland comprised around 5 percent of total territory. Approximately one sixth of the entire reported area in Goa is comprised of culturable waste. The state of Rajasthan contains the most cultivable wasteland, around 36 percent, followed by the states of Gujarat, Maharashtra, Uttar Pradesh, and U.P.

Land not available for cultivation

This class can be classified in two types:

a) Land put to non-agricultural use.

b) Barren and uncultivable land.

The area devoted to non-agricultural purposes includes land that is occupied by towns and villages, roads and highways, rivers and lakes, and other such features. The term barren land refers to any land that is uninhabitable and uncultivated, including that found in rocky places, mountains, and deserts. These lands cannot be tilled without incurring a significant financial burden and risking poor returns on the investment. There is 13.8 percent of land in India that is not suitable for agricultural use. The states of Andhra Pradesh and Rajasthan have the most land in this category. M.P, Gujarat, U.P. Bihar.

Permanent Pastures and other grazing land

Permanent pastures and other types of grazing fields cover an area equal to about 10 million hectares in its entirety. This is around 4 percent of the entire area. One third of the total land area of Himachal Pradesh is made up of pastures and other grazing areas. Other important states that belong to this class include Karnataka, Gujarat, and Rajasthan. M.P. also belongs to this class.

Fallow Land

The term fallow land refers to any area that has previously been utilised for agricultural purposes but is now unusable for that use. It is possible to divide it into two categories, namely:

- Current fallow.
- Fallow other than current fallow.

A fallow field is one that has been left uncultivated for between one and five years in order to assist the soil in naturally regaining its fertility. A fallow that has lasted for one year is referred to as Current fallow, whereas a fallow that has lasted for two to five years is referred to as Fallow other than current fallow. Andhra Pradesh has the greatest area that is now fallow, accounting for around 2.2 million hectares. The next in line are the states of Maharashtra, Rajasthan, Uttar Pradesh, and Karnatka in that order.

The region designated as Fallow other than present fallow is most extensive in Rajasthan, followed by Andhra Pradesh in terms of total area.

Land under tree crops and groves

The term land under tree crops and groves refers to any cultivable land that is not included in the net displayed area but that has been used for aquaculture in some capacity. This category accounts for around one percent of the total area that has been recorded for the nation.

In this particular category, Orissa has the most land area, followed by Uttar Pradesh, Bihar, and Karnataka.

MINERALS

Minerals are very important natural resources despite the fact that their supply is limited and they cannot be replenished. They make up the essential raw materials for a wide variety of

essential industries and are an important resource for the advancement of humankind. The practise of mining for minerals in India has a long and illustrious history that extends back to the Harappan culture. The extensive availability of the minerals in the form of vast and rich reserves created an environment that was highly favourable for the expansion and development of the mining industry in India.

The nation has vast reserves of both metallic and non-metallic minerals, making it a mineral-rich nation. The mining industry plays a significant role in the Indian economy. Since the country gained its independence, there has been a significant increase in the output of minerals, both in terms of the quantity and the value. Minerals that constitute primary mineral raw materials for industries such as thermal power generation, iron and steel, ferroalloys, aluminium, cement, various types of refractories, china clay-based ceramics, glass, and chemicals such as caustic soda, soda ash, calcium carbide, and titania white pigment have continued to be wholly or largely produced within India. India is largely independent in the production of coal (with the exception of very low ash coking coal required by the steel plants) and lignite among mineral fuels; bauxite, chromite, iron, manganese ores, and rutile among metallic minerals; and almost all of the industrial minerals, with the exception of chrysotile asbestos, borax, fluorite, kyanite, potash, rock phosphate, and elemental sulphur. In spite of a high degree of self-sufficiency, certain quantities of flaky and amorphous graphite of high fixed carbon, kaolin and ball clay for special applications, very low silica limestone, dead-burnt magnesite and sea water magnesia, battery grade manganese dioxide, etc. were imported to meet the demand for either blending with locally available mineral raw

materials or for manufacturing special qualities of mineral-based products. These materials were imported for either of these purposes. India's cutting and polishing industry continued to rely on imports of raw uncut stones for their value-added re-exports because of the rising demand for uncut diamonds, emeralds, and other precious and semi-precious stones. This was necessary for India to meet the growing demand for these types of stones.

MINERAL BELTS OF INDIA

The most notable aspect of the minerals found in India is the chaotic dispersion of those minerals. While some areas are utterly bereft of this asset entirely, certain locations are quite wealthy. The thick layer of alluvium that covers the north Indian plain contributes to the region's lack of mineral resources. The geological structure of the Himalayas is very complicated, despite the fact that they include a wide range of materials. Mineral extraction is not likely to be profitable due to the challenging terrain and few quantities that may be found in any one location. The ancient, crystalline rock formations of the plateaus and low hills on the peninsula are the only places where the rich mineral zone with significant quantities may be found. There are clearly delineated mineral belts, and they may be characterised as follows:

(1) North-Eastern Peninsular Belt:

1. This belt has the greatest concentration of mineral deposits in all of India. It is made up of the Chotanagpur plateau as well as the Orissa plateau, both of which can be found in Jharkhand, West Bengal, and Orissa. The Chhotanagpur plateau is renowned as the Ruhr of India and the mineral heartland of India.

Large amounts of coal, iron, manganese, mica, bauxite, copper, chromites, and kyanite may be found in this area.

(2) Central Belt:

This belt has the distinction of being India's second-largest mineral belt. It is made up of the states of Chhattisgarh, Andhra Pradesh, Maharashtra, and M.P.

It has significant reserves of a variety of minerals, including manganese, bauxite, limestone, marble, coal, jewels (Panna), mica, iron ore, and graphite, among others.

(3) Southern Belt:

The majority of the Karnataka plateau and the adjacent uplands of Tamil Nadu make up this belt. This belt, like the north east peninsular belt, is rich in ferrous minerals and bauxite, but it is devoid of coal, save for the lignite that can be found in Neyveli (T.N.), mica, and copper deposits.

(4) South-Western Belt:

This belt encompasses the western portion of Karnataka as well as the state of Goa. This belt is home to significant quantities of garnet, clay, and iron-ore.

(5) North-West Belt:

North West belt Extends along the Aravallis in Rajasthan as well as in areas of Gujarat that are adjacent to the state. Non-ferrous mineral resources such as uranium, mica, stealite, beryllium, precious stonesite, gypsum, manganese, and salt are abundant in this region. Other non-ferrous mineral resources include precious stonesite. This area is quickly establishing itself as a significant producer of petroleum.

(6) The Indian Ocean

In addition to the presence of petroleum and natural gas in the offshore regions, the sea floor also includes manganese nodules, phosphorite nodules, and barium sulphate concentration.

The water at depths more than 4,000 metres has the highest concentration of nodules of superior grade. Near the Andaman Islands is where phosphate nodules are most often discovered.

DISTRIBUTION OF MINERALS IRON ORE:

Iron is essential to the development of modern industry and is often considered to be one of the most significant metals in use today. Ore found in mines may be used to smelt iron into finished products. The following types of iron ore may be differentiated from one another according to the proportion of iron that they contain:

(A) Magnetite - contains 72% pure iron.
(B) Hematite - contains 60-70% pure iron.
(C) Limonite - contains 40-60% pure iron.
(D) Siderite - contains 40-50% pure iron.

The distribution of two main varity is as follows:

type	Haematite	Magnetite
reserves	~18000 MT	~10500 MT
Major states	1.Odisha(33%) 2.Jharkhand(26%) 3.Chhasttisgarh(18%)	1. Karnatka(73%) 2. Andhra Pradesh(14%) 3. Rajasthan(5%)

(A) Magnetite ores:

This kind of ore in India is either of volcanic origin or metamorphosed banded magnetic silica deposits, which are

presumably of sedimentary type. Either of these three possibilities might have occurred. The Dharwar and Cuddapah system of the peninsula is where you'll find it. The most important regions are:

(i) **Karnataka:** Kudremukh deposits.

(ii) **Tamil Nadu:** Salem, Nilgiri, and Dharampuri.

(iii) **Andhra Pradesh:** At the trijunction of Adilabad, Karimnagar and Nizamabad dist. and Khammam and Warangal dist.

(iv) **Kerala:** Kozhikode dist.

(B) Hematite Ores: In addition to this, you may find it in the Dharwar and Cuddapah system on the peninsula. The haematite iron ores of India are concentrated in the eastern region of the nation in the states of Jharkhand, Odisha, Chhattisgargh, and Andhra Pradesh. This area accounts for close to roughly 80 percent of the country's total supply. The states of Karnataka, Maharashtra, and Goa are all significant producers in the western region. The following is a list of the primary producing regions in these states:

Odisha: Odisha is the state that produces the most iron ore out of any other in the nation. In the state of Odisha, it may be found in the following four distinct areas:

- Hirapur in Nabarangpur
- Daitari-Tomka in Jajpur
- Badampahar-suleipat-Gurumahisani in Mayurbhanj
- Joda-koira in Keonjhar and Sundergarh district.

Jharkhand: Noamandi mines in Singhbhum are richest mines.

Chhattisgarh and Eastern Maharashtra region:

(a) Bailadila, Raoghat (Bastar dist.)

(b) Dalli-Rajhara group (Durg dist.)

(c) Lohara-piplagaoh and surajgarh deposits(Eastern Maharashtra).

Karnataka:

(a) Sandur range (Bellary dist.)

(b) Bababudan Hills (Chikmanglur dist.)

(c) Tumkur, Shimoga&Chitradurg dist.

(d) North Kanara deposit.

Goa-Ratnagiri area:

Goa: North (rich), Central (medium), South(poor

Ratnagiri dist.

Rajasthan: Bhilwara & Udaipur dist.

(C) Limonite & Siderite: Damuda series(Raniganj coal field), Garhwal (Uttaranchal)and Mirzapur dist. of U.P. and KangraValley (H.P.)

Production of Iron Ore:

Leading Producing state
1.Odisha(55%)
2.Chhattisgarh(17%)
3.Karnatka(14%)

MANGANESE ORE:

An essential mineral, manganese is put to work in the production of a variety of products, including steel, paint, pesticide, batteries, and bleaching powder. India is the fifth greatest producer of manganese after Brazil, Gabon, South Africa, and Australia. Her manganese ore reserves are the second highest in the world, behind only those of Zimbabwe. Ores of manganese may be found in the sedimentary rocks of Dharwar.

Together, the states of Maharashtra and Madhya Pradesh are responsible for producing more than half of India's total output.

State wise Reserves and Production:

Reserves	Production
1. Odisha (44%)	1.Madhya Pradesh (33%)
2.Karnatka(22%)	2.Maharashtra (25%)
3.Madhya Pradesh(12%)	3.Odisha(19%)

Main Production centres are:

1.Maharashtra - Nagpur, Bhandara, South Ratnagiri
2. **M.P.** - Balaghat, Chhindwara, Jabalpur, Jhabna
3 Orissa - Sundergarh, Kalahandi, Koraput, Keonjhar, & Mayurbhanj
4.**Karnataka** - Sandur, N.Kanara, Tumkur, Shimoga

5. **Jharkhand** – Singhbhum
6. **Rajasthan** - Udaipur, Banswara
7. **Andhra Pradesh** - Vishakhapatnam, Srikakulam.

COPPER:

Copper is a malleable and ductile metal that has a very high thermal and electrical conductivity. It is also soft and pliable. It finds widespread use in the manufacture of cutlery, electrical apparatus, wires, cables, and automotive components, among other things. Cuprite, Malachite, chalcocite, Bronite, Chalcopyrite, and Azurite are all important forms of copper ore. Themajor states having reserves and production of copper are as follows:

Reserves	Production
Rajasthan(50%)	Madhya Pradesh(53%)
Madhya Pradesh(24%)	Rajasthan(43%)
Jarkhand(19%)	Jharkhand(4%)

• The main **Production centres of these states are:**

Rajasthan - Khetri copper belt - (a) Mandan Kaddhan section (b) Kolihan section (c) Dariba.

Jharkhand - Singhbhum copper belt

Madhya Pradesh - Balaghat

LEAD and zinc:

Because of its malleability, its weight, and the poor heat conductivity it has, lead is a metal that is utilised extensively. Galena, a cubic sulphide that may be found in the veins of limestone, sandstone, and slate, is the only form in which it can be found in nature; it does not exist in its free form.

Zinc is found in combination with galena, chalcopyrite, iron pyrite, and other sulphide ores. Lead and zinc are both components of the mixed ore that makes up zinc.

Reserves
1.Rajasthan(89%)
2.Andhra Pradesh(3%)
3.Madhya Pradesh(2%)

Almost entire production come from Rajasthan.

Major mines inRajasthan are: -

- Rampura Agucha mine
- Sindesar khurd mine
- Kayad mine
- Zawar mines
- Rjpura Dariba mine

GOLD:

Gold is a valuable metal that may be found in lodes with auriferous deposits. It is possible to find it in the sand found in rivers. The state of Bihar in India has 44 percent of the country's primary gold ore deposits. This is followed by the states of Rajasthan (25 percent), Karnataka (21 percent), and Andhra Pradesh (21 percent) (3 percent).

• Karnataka and Andhra Pradesh are the states with the greatest gold production rates due to the presence of three significant gold resources in each of these states. These include:

(i) Kolar gold field - Kolar dist. (Karnataka)

(ii) Hutti gold field - Raichur dist. (Karnataka)

(iii) Ramgiri gold field - Anantpur dist. (Andhra Pradesh)

• **Alluvial gold** - Gold is also found in the alluvial sand and gravels of many streams

and rivers.

• Important regions are:

Jharkhand - Subarnarekha, Sona nadi, streams draining Sonapat Valley.

• **Kerala** - River terraces along Panna Puzha&ChakiyePuzha.

• Largest producers - (i) Karnataka (ii) Andhra Pradesh (iii) Jharkhand.

SILVER:

•Silver is another precious metal , valued next only to gold. The chief ores of silver are : Argentine, Stephanite, Pyrogyrite and Pronstite. Itis found mixed with othermetal such as copper, lead, gold , zinc etc.

Important silver proction centres are:

- Zawar mines (Rajasthan),
- Kolar gold fields and Hutti gold mines of Karnataka.
- Dhanbad and Singhbhum of Jhakhand

Largest producer - (i) Rajasthan (ii) Jharkhand (iii) Karnataka.

BAUXITE:

Bauxite is an important ore of Aluminium. Its deposits were formed mainly in tertiary period. It is associated with Laterite rocks.

• Largest reserves:

(i) Orissa(52%)
(ii) Andhra Pradesh(18%)
(iii) Gujarat(7%)

• Largest Producers:

(i) Orissa: The state of Orissa is responsible for more than one third of India's total bauxite output, making it the

country's leading producer. The primary centres are Kalahandi,Koraput Sundergarh Bolangiri Sambalpur.

Chhasttisgarh: The second biggest producer in India, Chhattisgarh is responsible for around 19 percent of the country's total output. The most important urban areas are located in Bilaspur, Durg, and the Amarkantak plateau region.

(ii) Maharashtra: With 15 percent of India's total output, Maharastra is the third biggest producer in the country. Kolhapur, Thane, Ratnagiri, and Stara and Pune are the most important locations. (iii) Jharkhand is also important.

MICA:

Mica is a valuable material that is used in the construction of electrical products. It has a minimal power loss and the ability to handle high voltage. The following are the three most common kinds of mica found in India:(i) Muscovite (Potash mica) (ii) Biotite (Iron magnesium mica) (iii) Phlogopite.

The reserves of mica are as follows:

Reserves
1. Andhra Pradesh (41%)
2 Rajasthan(21%)
3 Odisha(20%)

Productions areas: India is thelargest producing country of the world. In India Andhra Pradesh produses more than 93%of total production of country. Rajasthan and Jharkhand are second and Third largest states respectively. The chief producing centers are as follows:

Andhra Pradesh:

The Nellore district includes the mica belt in its territory. The colour of nellore mica is often described as a pale green.

Rajasthan:

- In southwest Rajasthan, the mica belt stretches all the way from Jaipur to Udaipur. The most significant centre is located in Bhilwara. Mica might seem pink or light green in this context.

Jharkhand :

A belt that extends from Gaya to Bhagalpur and has a length of 150 kilometres and a breadth of 20 kilometres passes through Hazaribagh, Giridih, and Munger. This belt is home to the most abundant deposits of premium Ruby-mica and Bengal-mica in the whole world. The most significant centre and the biggest mica market in the world is located in Kodarma.

FOSSILS FUEL MINERALS:

COAL:

- Coal is the largest source of energy in the United States, accounting for around 68 percent of the country's total commercial energy consumption.
- In this country, the coal-bearing strata may be divided into two primary types, which are:

(i) **Gondwana Coalfields:** In India, it is responsible for 98 percent of the country's total coal reserves and 99 percent of the country's total coal output. The rock system of lower Gondwana age is home to 80 of India's 113 main coalfields. These fields may be found over the whole of India. In the valleys of certain rivers, such as the Damodar (Jharkhand-West Bengal),

Mahanadi (Chhattisgarh-Orissa), Son (M.P.-Jharkhand), Godavari & Wardha (Maharashtra-Andhra Pradesh), Indravati, Narmada, Pench, and Kanha, there are approximately 75 separate basins. These basins are primarily confined to the peninsular region of India.

(ii) Tertiary Coalfields:

Calfield for tertiary crops Contains coal that is of a more youthful age. They are mostly restricted to areas outside of the peninsula, including Assam, Meghalaya, Arunachal Pradesh, and Nagaland, as well as the foothills of the Himalayas in Darjeeling, West Bengal, Jammu and Kashmir, Uttar Pradesh, Rajasthan, Kerala, Tamil Nadu, and the Union Territory of Pondicherry. In terms of its quality as a fuel source, Assam coal is among the best, whereas the coals of Kashmir and T.N. have a lower proportion of fixed carbon.

Types of Indian Coal:

1. **Anthracite** (80-95% carbon)- it is found only in J&K and that too in small quantity.
2. **Bituminous** (40-80% carbon)- most of it is found in Jharkhand, Orissa, W.Bengal, Chhattisgarh and M.P.
3. **Lignite** (40-55% carbon)- it is found in Palan (Rajasthan), Neyveli (T.N),Lakhimpur (Assam) Karewa (J&K).

Distribution:

The majority of India's coalfields may be located in the country's eastern region, more specifically to the east of 78 degrees of east longitude. The north-eastern portion of the peninsular plateau has the greatest amount of coal resources. This region includes sections of Jharkhand, Chhattisgarh, Orissa, eastern Maharashtra, and the western portion of West Bengal. Adjacent areas of Maharashtra also have huge coal deposits.

Majer centers of Gondwana Coal:

• **Jharkhand:** Both the amount of coal reserves that India has (26 percent) and the amount of coal that is produced is highest in the state of Jharkhand. Jharia, Bokaro, Giridih, Dhanbad, Karnapura, and Ramgarh are among of the major locations. The majority of the coal resources are concentrated in a very small band that runs nearly exactly parallel to 24 degrees north latitude.

Orissa: The state of Orissa has second largest coal reserve (24%) in country. Major centers are Dhenkanal, Sambalpur and Sundergarh dist. The Talcher coalfield is the most extensive calfield in all of Orissa.

Chhattisgarh: Chhattisgarh has 17 percent of the world's total coal resources, making it the third biggest state in terms of its coal reserves. Hasdeo-Arand, Korba, Chimiri, Johilla, and Jhimli are the primary coalfields in this region.

West Bengal: With 11 percent of the nation's total deposit, West Bengal has the fourth highest coal resource in the country. Major centres include Raniganj, Burdawan, Purulia, Virbhum, Jalpaiguri and Darjeeling. The Raniganj coalfield is the most extensive.

Other main centers in differntsates are as follows:

Andhra Pradesh: Singrauni, Tandur, Kathagudam (Godavari Valley has the largest reserves)

Maharashtra: Kamptee, Wardha Valley, Ballarpur and Warora (Chandrapura dist.)

U.P: Singrauli coal fields (Mirzapur dist.)

Tertiary Coal:The statewise distribution of tertiary coal is as follows:

• **Assam:** Makum, Nazira, Mikir hills, and Dilli-Jeypore (Makum coalfield in Sibsagar dist. is most developed)
• **Rajasthan:** Palan-Bikaner.
• **Meghalaya:** Garo, Khasi and Jaintia hills.
• **Arunachal Pradesh:** Namchick-Namrup coalfield (Tirap dist.)

PETROLEUM:

The sedimentary rocks that formed throughout the Mesozoic and Tertiary eras in India are the only ones that have petroleum deposits. The sedimentary rocks span around 14 million square kilometres of land throughout the nation. The marine basins take up about 10 lakh square kilometres of this total 14 lakh square kilometres.

At the moment, crude oil may be extracted from both on-shore and off-shore locations. The percentage of crude oil output that comes from offshore locations is around 50.01 percent. The following six states are responsible for the domestic production:

1. Rajasthan (21.82%)
2. Gujarat (13.53%)
3. Assam (12.5%)
4. Tamil nadu (1.15%)
5. Andhra Pradesh (0.87%)
6. Arunacha Pradesh (0.13%)

Important Oil fields:

(i) **Assam:** Digboi, Naharkatiya, Hagrijan- Moran, Surma valley, Rudrasagar and Lakwa are new regions.

(ii) **Gujarat:** Cambay, Ankleshwar, Kabul, Nawgam, Kosamba, Dholka, Sanand.

(iii) **Bombay High (Mumbai High):** Production began in 1976 at this offshore construction that spans 2500 km2 and is located 176 kilometres off the coast of Mumbai. Approximately two-thirds of India's entire output comes from this region.
(iv) **Bassein:** area recently found off the coast of Mumbai, to the south of Mumbai High.
(v) **Aliabet:** Positioned in the Gulf of Cambay on the island of Aliabet. Production geared for sale is anticipated to begin very shortly.
(vi) **Krishna-Godavari Basin:** Ravva field

Oil Refineries:
At the moment, the nation is home to 23 refineries, 18 of which are owned and operated by the public sector, 2 by joint and private sectors, and 3 by private sectors alone.

Public Sector Refineries: Digboi, Nunmati, Bongaigaon and Numaligarh in Assam, Barauni (Bihar), Haldia (W. Bengal), Vishakhapatnam (Andhra Pradesh), Chennai &Narimanam (T.N), Kochin (Kerala) Trombay (Maharashtra), Koyali (Gujarat), Karnal, Panipat (Haryana), Mathura (U.P.)

- **Joint sector Refineries:** Mangalore (Karnataka).
- **Private sector Refinery:** Jamnagar (Gujarat).

• The first refinery was established at Digboi is 1901.
• Jamnagar (Gujarat) refinery has the largest capacity followed by Koyali

Natural Gas:

Although it may be obtained alone or in combination with crude oil, the vast majority of the supply originates from related sources. The Ankleshwar and Cambay gas fields are located in Gujarat, while the Mumbai High and Assam gas fields are located in India. Refineries that process petroleum also generate fuel gas as a byproduct. Approximately 67.3 percent of total production of natural gas comes from offshore areas. The majority of the natural production that is still available originates from the following sources:

1. Assam10%
2. Rajasthan5%
3. Tripura 5%
4. Gujrat 4%
5. Tamil nadu4%
6. Andhra Pradesh 3%

ATOMIC MINERALS :

Uranium and thorium are the two primary atomic minerals. Uranium occurs in substantial proportion in minerals like pitchblende , uranite,autunite etc. The first uranium deposit in India was found in 1951 at the city of Jaduguda, which is located in the state of Jharkhand. There are further mines in the region of Jharkhand known as Narwaphar, Turamdih, and Bagjata. The other important deposits are Bodal in Chhatisgarh , Jajawal in Madhya Pradesh,Domiasiat,wahkyn nd tyrani Meghalaya and Lambapur-Peddagattu and Tummalapalle in Andhra Pradesh.

In addition to uranium, monazite sand may be used to produce zirconium. Although monazite sand may be found on both the east and west coasts, the greatest concentration of the mineral can be found along the coast of Kerala, namely between Cape Comorin and Quilon. The mineral monazite, as well as the mineral thorianite, are both sources of thorium. The states of Kerala, Jharkhand, Bihar, Tamil Nadu, and Rajashan are the primary producers of thorium.

ZIRCONIUM & ILMENITE:

Deposits of commercial value occur is the beach sands of Kerala coast.

PROBLEMS ASSOCIATED WITH MINERAL RESOURCES

a) Depletion of mineral resources: The overexploitation of several different minerals will lead to their eventual depletion in the near future. Therefore, we need adequate mineral policy in order to ensure the scientific conservation of minerals.

b) Ecological problems: The exploitation of minerals has resulted in significant concerns for the environment. Large swaths of agricultural land have been made almost unusable as a result of the rapidly expanding mining industry. Large tracts of land have been cleared of their natural vegetation. In mountainous mining regions, landslides are a common occurrence that may result in the death of people and the destruction of property.

c) Pollution: The process of extracting minerals from the earth results in several types of pollution, including radioactive contamination, noise pollution, soil pollution, and air pollution.

d) Social problems: When new mines are discovered or when a new mining business is established, significant numbers of the

local populace are required to relocate. They will essentially become refugees as a result of this. They are more likely to get infections as a result of the pollution caused by the mining extraction.

CONSERVATION OF RESOURCES

In a world with dwindling resources, it is very necessary for the current generation to make prudent use of the earth's mineral resources in order to preserve a resource basis for the generations who will follow after them.

The strategies include:

a. New studies need to be carried out in order to discover and cultivate substitute minerals that can be used in lieu of limited minerals that are now in short supply and are likely to be depleted in the not too distant future.
b. It is necessary to continue doing research in order to create new technologies that will reduce the amount of waste produced and maximise the exploitation of by-products.
c. There should be restrictions placed on wasteful mining practises that are also harmful to the environment.
d. Use of alternative energy sources such as solar energy, hydroelectric energy, and other such sources.
e. Taking steps in the direction that will eventually lead to sustainable growth.
f. Utilize clean and sustainable energy sources.
g. It is important to refrain from mining the mineral resources to excess.
h. Cooking might benefit from switching to biogas as a fuel source rather than traditional non-renewable energy sources.