1. Details of Module and its structure

Module Detail	
Subject Name	Geography
Course Name	Geography 02 (Class XI, Semester - 2)
Module Name/Title	Unity and Diversity in relation to structure and physiography
Module Id	kegy_20204
Pre-requisites	Basic concepts about Unity and Diversity in relation to structure and physiography of India
Objectives	After going through this lesson, the learners will be able to understand the following: • Impacts of Deccan Plateau on Himalayas and Northern Plain. • Impacts of Himalayas on Peninsular Plateau and Northern Plain. • Impacts of Indian Ocean and Himalayas on the Climate, Environment, Culture and Civilization in India.
Keywords	Tethys sea, Gondwanaland, Eurasian Plate, Antecedent Rivers, Ganga Plain, Malda Gap, Biodiversity Hotspot

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India: Unity and Diversity in Relation to Structure and Physiography.

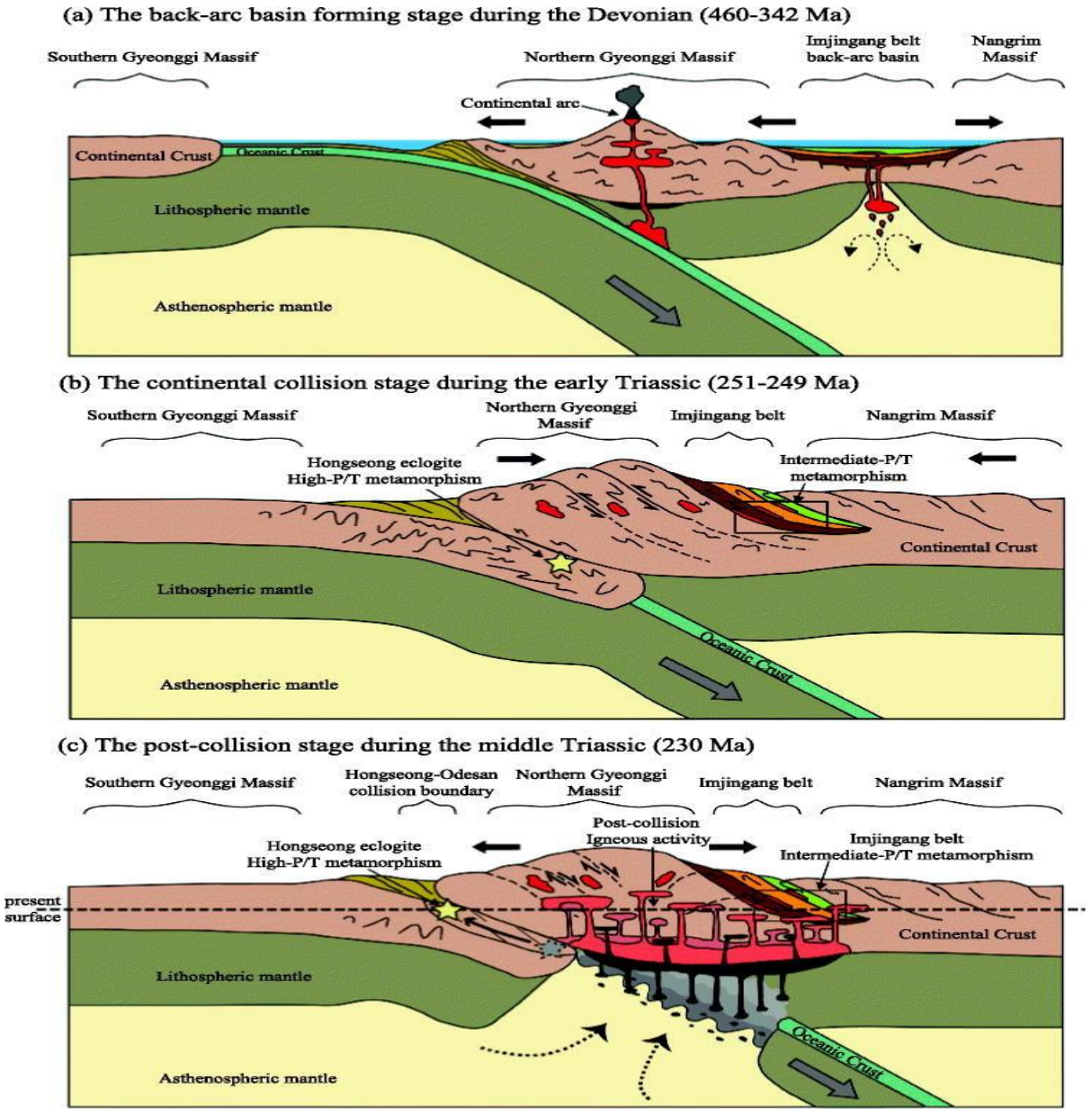
India is the seventh largest country in World in term of its area and second to China in terms of population. So, it is but natural that a country with an area of 32.87 lacs sq. km. spread between 68.7 - 97.25 East Longitudes and 8.4 – 37.6 North Latitudes has diversity in terms of its Structure and Physiography. But, it would be in correct to conclude from the above that diversities are impediments in the unity of India. On the contrary, the diversity provides the strong ground for its unity.

https://mapswire.com/maps/world/world-physical-map-mercator-large.jpg

Diversity and unity in relation to the Three Tectonic Divisions i.e. the Deccan Plateau, Himalayas and Northern Plain

The Himalayan Mountain system was built over millions of years of movement of Indian Plate (Gondwanaland) from the South and the Eurasian plate in the North and both exerting their pressure on the deposits at the Tethys Sea separating both. The intensity as well as magnitude of the movement and the pressure exerted varied over time resulting into the emergence of series of almost parallel mountain ranges of the Himalayas of different heights, alignments and

directions separated by numerous thrust planes, boundary faults and deep gorges. Region, which represents the northern platform of the Peninsular India belonging to East Gondwanaland, was strongly affected by Pan-African diastrophism 500 million years ago. This brought to an end the protracted Purana cycle of sedimentation throughout the Peninsular India and the Lesser Himalaya and interrupted basin-filling in its northern Tethyan domain. But the sea returned in the Early Permian along a narrow depression formed due to rifting of the Himalayan crust in what is today the southern Lesser Himalaya. In the rift valley was deposited tillite by glaciers of the Gondwana continent under grip of glaciation. The rifting culminated in the breaking away of the Tibetan part of the Himalaya in the Late Permian and formation of Neo-Tethys between the Gondwanaland and the Cimmerian micro-continent embodying Tibet, Iran and Turkey.



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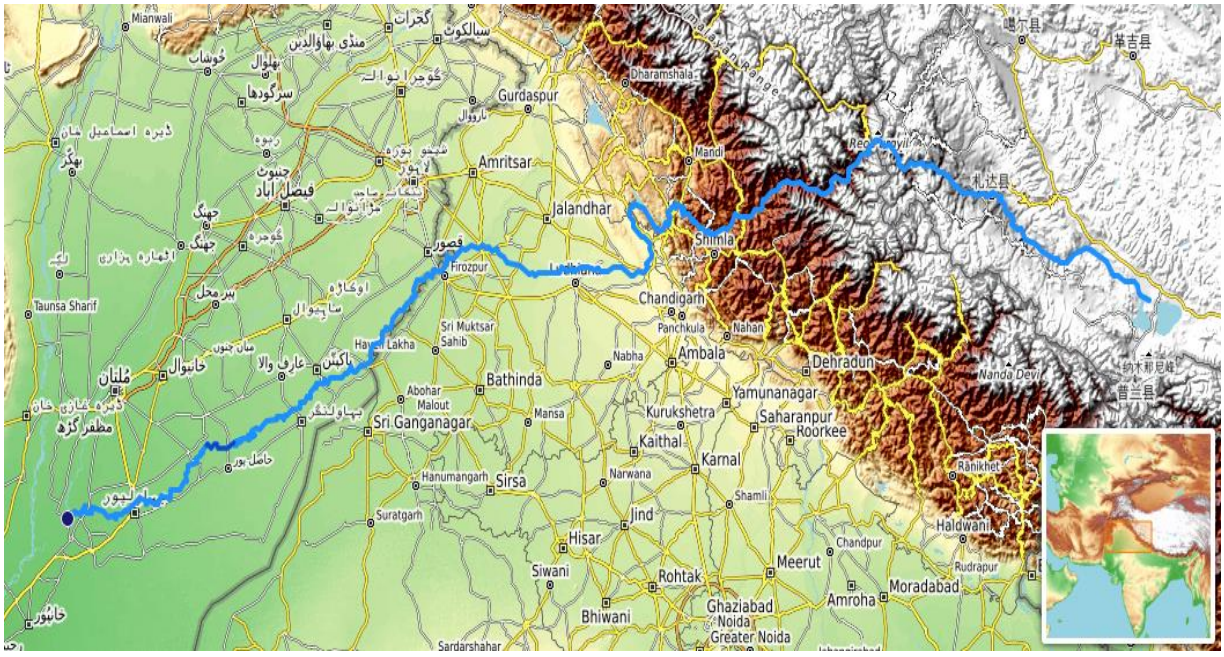
Rivers of the northern Peninsular India flowed in the northerly directions since the Middle Proterozoic through Early Eocene. In the Late Eocene there was a drastic drainage reversal to south and southeast when the Himalaya emerged in the northern front of the Gondwanaland.

The major Himalayan Rivers rise north of the mountain ranges and flow through deep gorges that generally reflect some geologic structural control, such as a fault line. The rivers of the Indus system as a rule follow north-westerly courses, whereas those of the Ganges-Brahmaputra systems generally take easterly courses while flowing through the mountain region.

In addition, there are evidences to support that the rivers flowing out of the Tibet area over the Indian plate must have existed before the upper Cretaceous i.e. before the Himalayas began to rise, which imply presence of a unified landmass comprising India-Tibet. Many Himalayan rivers are good examples of antecedent origin. These rivers originated well before the Himalayan region was uplifted. The rivers Indus, Brahmaputra, Sutlej, Kosi and Subansiri originated on the Tibetan side and now traverse the existing mountain ranges, cutting deep gorges.



Sutlej River

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Sutlej River in Kinnaur Himachal Pradesh

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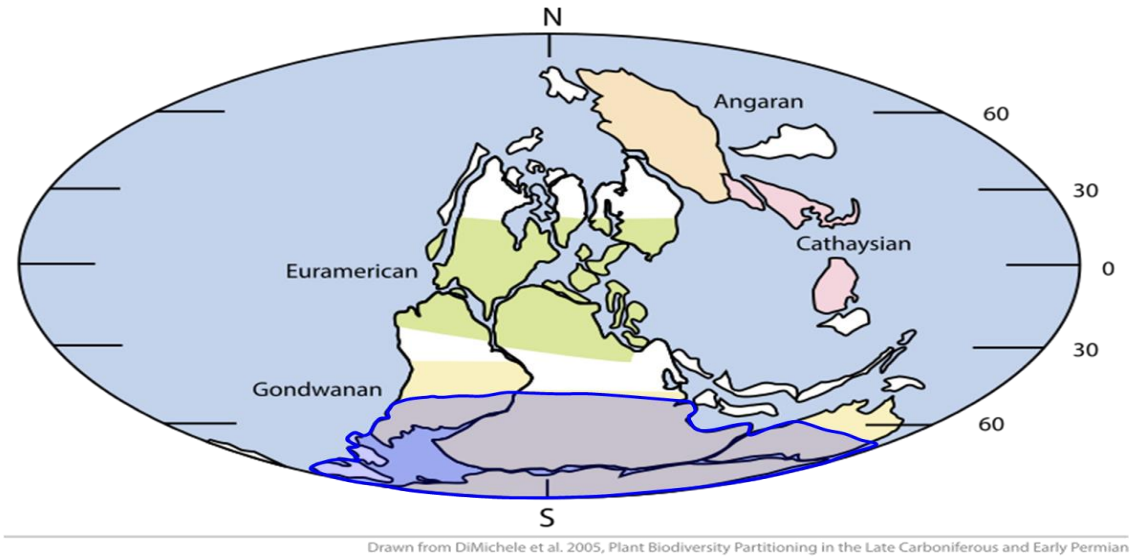
An **antecedent stream** is a stream that maintains its original course and pattern despite the changes in underlying rock topography.



Late Paleozoic ice caps

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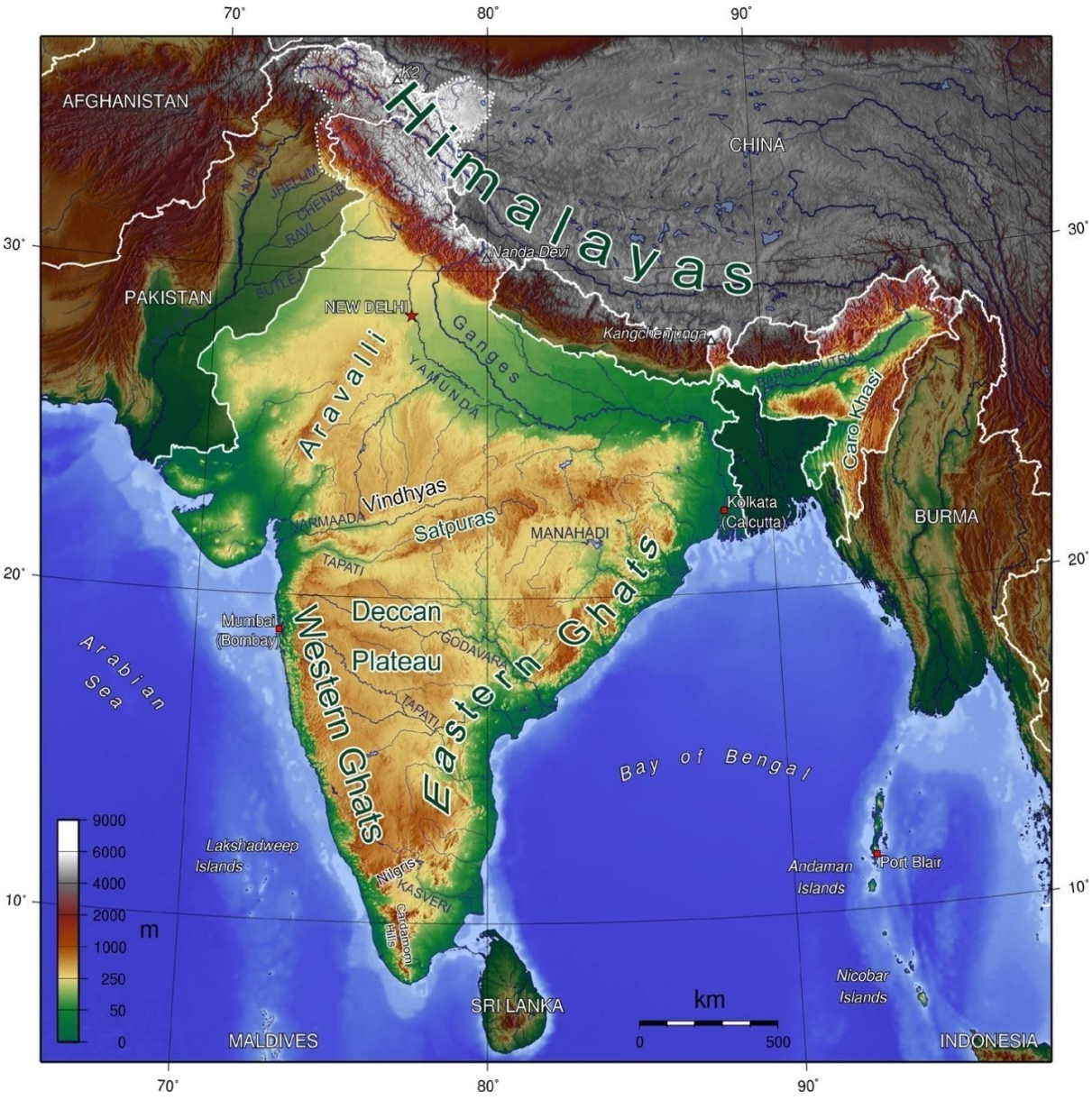
The occurrence of Upper Gondwana rocks in the Peninsular India, Lesser and Tethys Himalaya of Indo – Nepal and Bhutan areas strongly suggest that sediments of these different regions were located on the Gondwanaland. Gondwana began to drift apart during the Late Jurrassic. The collision took place during Mesozoic and Cenozoic times, with the northern margin of the Tethys, as the oceanic lithosphere of the Paleo-Tethys Ocean was subducted below Laurasia. The present day relationships among orogenic belts are further complicated by the strike-slip movements, convergence rates among plates from the Himalayas to the Alps. Before India – Asia collision, India moved northward about 20 cm/ year double as fast as any plate between 67 and 52 Ma.

The north-facing slopes of Himalayas generally have a fairly thick soil cover, supporting dense forests at lower elevations and grasses higher up. Some of the wet deep upland soils of that type in the eastern Himalayas—in Darjeeling Hills and in the Assam valley—have a high humus content that is good for growing tea. Farther east, saline soils occur in the dry high plains of the Ladakh region. Of the soils that are not restricted to any particular area, alluvial soils (deposited by running water) are the most productive, though they occur in limited areas, such as the Kashmir valley, the Dehra Dun, and the high terraces flanking the Himalayan valleys.

The Aravalli Range, an eroded stub of ancient mountains, is the oldest range of folded mountains in India. The natural history of the Aravalli Range dates back to times when the Indian Plate was separated from the Eurasian Plate by Tethys Sea. The Aravalli Range is a northeast-southwest trending orogenic belt that is located in the northwestern part of Indian Peninsula. It is part of the Indian Shield that was formed from a series of cratonic collisions. In ancient times, Aravalli were extremely high but since have worn down almost completely by millions of years of weathering, whereas the Himalayas being young fold mountains are still continuously rising. Aravalli, being the old fold mountains, have stopped growing higher due to the cessation of upward thrust caused by the stopping of movement of the tectonic plates in the Earth's crust below them.



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The Rajmahal Hills forming the north eastern edge of the Chotanagpur Plateau are mostly made of basalt and are covered by lava flows (Basaltic Lava).They run in north-south direction and rise to average elevation of 400 m. These hills have been dissected into separate plateaus.

The peninsular plateau extends further east beyond the Rajmahal hills to from Meghalaya or the Shillong plateau. Garo-Rajmahal Gap known as Malda Gap separates this plateau from the main block. It is believed that due to the force exerted by the northeast ward movement of the Indian plate at the time of the Himalayan origin, a huge fault was created between the Rajmahal hills and the Meghalaya plateau. Later, this depression got filled up by the deposition activity of the numerous rivers. As a result, today the Meghalaya and Karbi Anglong plateau stand detached from the main Peninsular Block.

The Garo-Rajmahal gap represents a physiographic gap in the outcrop continuity of Satpura strike due to alluvial cover between Garo and Rajmahal hills. The major part of this gap lies in Bangladesh. It is the junction of continental foredeep basin (Ganga valley) in the north and the Bengal basin in the south. A major drainage system of Ganga and Brahmaputra rivers flows through this narrow region from the Himalaya to the Bay of Bengal. Earlier, many differing views have been put forward regarding its origin. The present paper has brought out the origin and evolutionary stages of the gap on the basis of integrated analysis of geological and geophysical data of India and Bangladesh. A crustal model for the gap area is also presented. It has been concluded that the gap had its embryonic origin during Permo-Carboniferous (Lower Gondwana) period and evolved through the geological time to its present form.

Impacts of Himalayas on Peninsular Plateau and Northern Plain

The Indian plate and Eurasia collided between 40 and 60 million years ago according to four observations, one being that there is no mammalian fossil record in India from around 50 million years ago. On its way, the Indian plate passed over the Reunion hotspot which led to volcanic activity, thus forming the Deccan Traps. Its collision with the Eurasian plate led to the rise of the Himalayas and the continuous tectonic activity still makes it an earthquake prone area. The Gangetic plains were formed by the deposition of silt by the Ganga and its tributaries into the area between the Himalayas and the Vindhya Range. The rock formations can be divided into the Archaean, Proterozoic (Dharwar system), Cuddupah system, Vindhyan system, Gondwana system, The Deccan Traps, Tertiary system, Pleistocene period and recent formations.

Due to the uplift of the Himalayas in the Tethys Sea, the northern part of the Indian Peninsula got subsided and formed a large basin. That basin was filled with sediments from the rivers which came from the mountains in the north and from the peninsula in the south. These extensive alluvial deposits led to the formation of the northern plains of India.

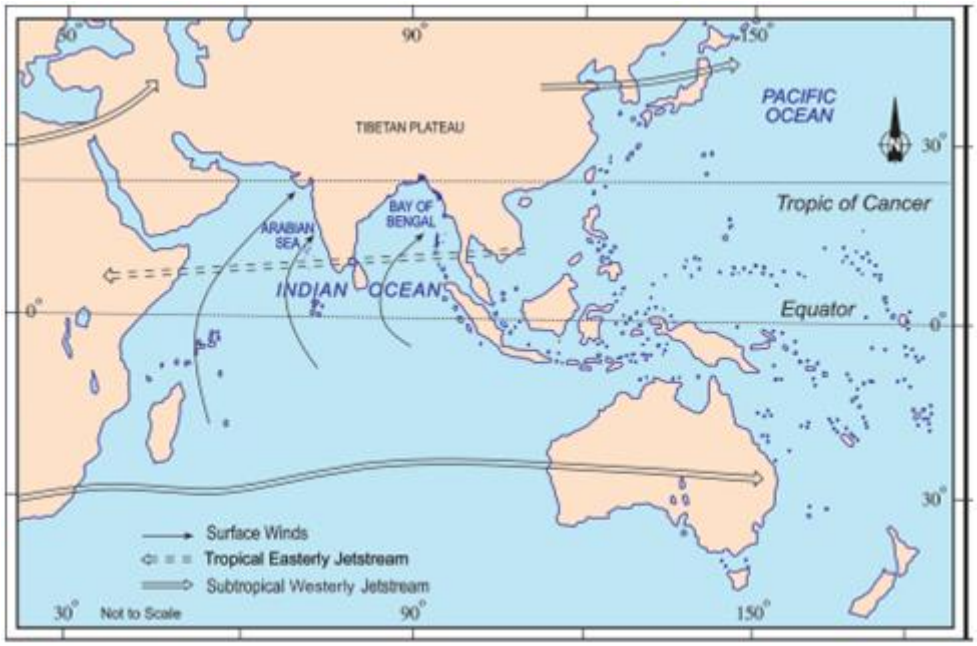
Impacts of Indian Ocean and Himalayas on the Climate, Environment, Culture and Civilization in India

(i) Impacts of Indian Ocean and Himalayas on the Climate of India

The whole monsoon system exists because of the Himalayan Mountains. This orographic rainfall and the thermal contrast between the land and the sea is a basic physical mechanism that drives atmospheric circulation. This in turn brings moisture from the Indian Ocean to the different part of India. It happens everywhere but here we have this massive mountain

that's like a heat pump. It heats up so significantly that – like a pump – it sucks moisture from the ocean and that is what we know as the monsoons.

When the monsoon wind hits the mountains, it rains. The wind is lifted up, cools, condensates and drops down as rain and snow. So that is how the glaciers are formed. That is how the snow cover is formed and that's why rivers are there.

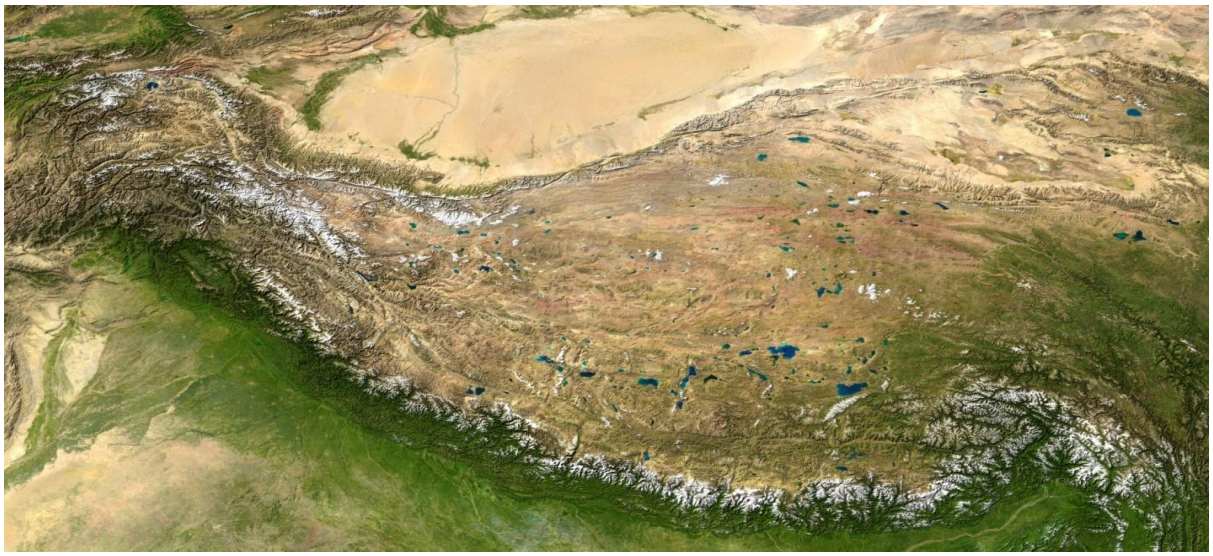


Monsoon winds

https://www.civilsdaily.com/wp-content/uploads/2016/12/monsoon-jet-stream.png

The Himalaya has formed a significant barrier to air-flow, both northwards and southwards, and this barrier effect is fundamental to determining the characteristics of the South West Monsoon. Today's South West Monsoon conditions were considerably weakened when both the Himalaya and the Tibetan Plateau were flattened to sea level, but its modern characteristics were retained when only the Himalaya were left in place. This suggests that the Himalaya have a major role in determining the primary characteristics of the monsoon circulation over South Asia.

The Himalaya acts as a barrier to winds from the north that may cool and ventilate the northwestern parts of the subcontinent during the summer. So, it is the presence of the Himalaya, which allows an intense hot low-pressure cell to develop and drive the South West Monsoon system.



Himalayas acting as a barrier

https://upload.wikimedia.org/wikipedia/commons/8/84/Himalaya_composite.jpg

Moreover Himalayas contain many glaciers which provide water to most of the rivers of north India. For example, Gangotri glacier provides water to river Ganga. And eventually river Ganga and its tributaries make the northern plain fertile and suitable for agriculture.

Further the Himalayas provide barrier not only for the invaders from the north but also the cold arctic and Siberian Winds and preventing it from becoming a desert similar to the Central Asian deserts: Takla Makan, Gobi etc. thus the Himalayas also became a climatic as well as cultural and civilisation divide, from coming to India as in previous time due to lack of transport it was difficult for them to cross Himalayas.

The climate comprises a wide range of weather conditions across a vast geographic scale and varied topography, making generalisations difficult. Given the size of India with the Himalayas, Arabian Sea, Bay of Bengal and the Indian Ocean, there is a great variation in temperature and precipitation distribution in the subcontinent. Based on the Köppen system, where the mean monthly temperature, mean monthly rainfall and mean annual rainfall are considered, India hosts six major climatic subtypes, ranging from arid desert in the west, alpine tundra and glaciers in the north, and humid tropical regions supporting rainforests in the southwest and the island territories. Many regions have starkly different microclimates.

The Indian Meteorological Department divides the seasons into four: Winter (mid-December to mid-March), summer (mid-March to May), Rainy (June to September), and Retreating Monsoon (October to mid-December)

The Indian Ocean, the Bay of Bengal and the Arabian Sea, exert moderating influence on the climatic conditions of India. These water bodies especially Indian Ocean provides much needed moisture to the summer monsoons, which provide heavy rainfall throughout the country.

Moreover, the climate of the coastal areas and Island groups of India is also modified by the influence of these water bodies. Many Tropical cyclones originates in the Indian Ocean, Bay of Bengal and Arabian Sea affects the life of people living in the Coastal area of the country.

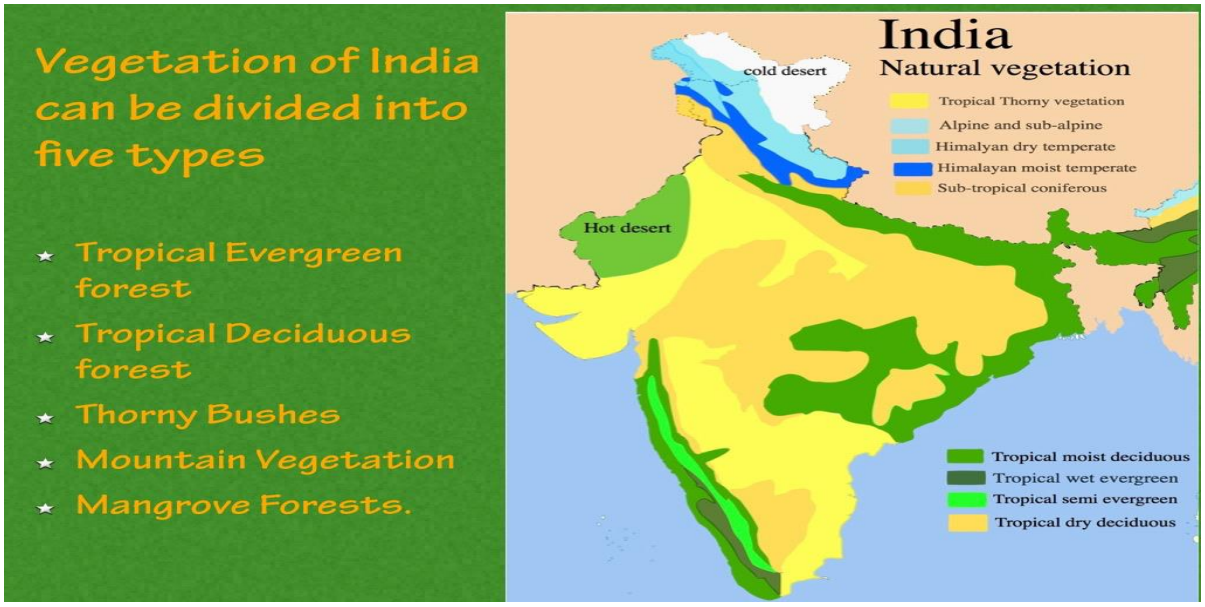
(ii) Impacts of Indian Ocean and Himalayas on the Environment of India

To understand the evolution of these unique diverse biotas we need to look back in time and consider their geological, climatological and biological context.

The biodiversity we see around us today is an expression of the dynamic interplay between topography, climate and life processes that operate over geological as well as biological timescales and is just flicker in the history of life.

Across India biodiversity hotspots fall under the influence of seasonally wet and dry regimes driven either by monsoon climates or seasonal migrations modified by land-sea thermal contrast and topography. Plants and animals across India have to be adapted to strong seasonal variations in rainfall, and on an annual basis tolerate water saturated soils and atmosphere for several months and extreme drought for several months. These extremes in water availability are often accompanied by marked variations in temperature and more complex climate metrics that have profound influences on photosynthesis.

Mountainous regimes such as those across much of India therefore combine all the main properties of global biodiversity hotspots: seasonal climate variation pre-adapts organisms to tolerate climate extremes and close proximity niche diversity is accompanied by repeated episodes of genetic isolation in 'sky islands' during warm climate phases, followed by down slope migration to mingle and hybridize in the lowlands during cool climate phases.



India's Biodiversity

https://dpsss6g.files.wordpress.com/2015/04/india-climate-vegetation-and-wildlife-012.jpeg?w=1024

The combination of complex topography and varying climates turns India into 'biodiversity factories'. With a wide range of climatic conditions from the torrid to the arctic, India has rich and varied vegetation, which only a few countries of comparable size possess. India can be divided into eight distinct-floristic-regions, namely, the western Himalayas, the eastern Himalayas, Assam, the Indus plain, the Ganga plain, the Deccan, Malabar and the Andamans.

Himalayas is the largest and youngest mountain chains in the world. Variations in its size, climate and altitudinal ranges have created environments unique and characteristic to this region only. The diverse climate and the varied environmental conditions of Himalayas support diverse habitat and ecosystems with equally diverse life forms.

The Western Himalayan region extends from Kashmir to Kumaon. Its temperate zone is rich in forests of **chir**, pine, and other coniferous and broad-leaved temperate trees. Higher up, forests of **deodar**, blue pine, spruce and silver fir occur. The alpine zone extends from the upper limit of the temperate zone of about 4,750 metres or even higher.

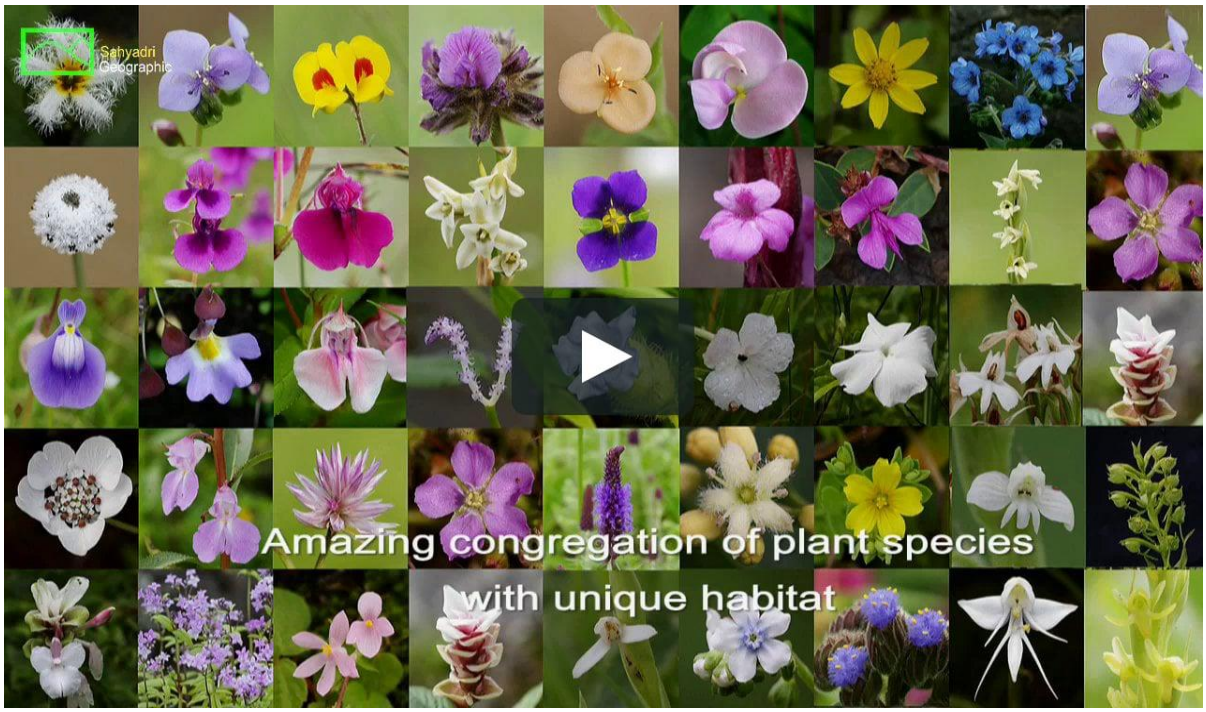
The vegetative characteristic of this zone are high-level silver fir, silver birch and junipers. The eastern Himalayan region extends from Sikkim eastwards and embraces Darjeeling, Kurseong and the adjacent tract. The temperate zone has forests of oaks, laurels, maples, rhododendrons, alder and birch. Many conifers, junipers and dwarf willows also occur here. The Assam region comprises the Brahmaputra and the Surma valleys with evergreen forests, occasional thick clumps of bamboos and tall grasses.

The Indus plain region comprises the plains of Punjab, western Rajasthan and northern Gujarat. It is dry and hot and supports the bushes and thorny desert vegetation. The Ganga plain region covers the area which is alluvial plain and is under cultivation for wheat, sugarcane and rice. Only small areas support forests of widely differing types.

The Deccan region comprises the entire tableland of the Indian Peninsula and supports vegetation of various kinds from scrub jungles to mixed deciduous forests. The Malabar region covers the excessively humid belt of mountain country parallel to the west coast of the Peninsula. Besides being rich in forest vegetation, this region produces important commercial crops, such as coconut, betel nut, pepper, coffee and tea, rubber and cashew nut.

The Andaman region abounds in evergreen, mangrove, beach and diluvia forests. The Himalayan region extending from Kashmir to Arunachal Pradesh through Nepal, Sikkim, Bhutan, Meghalaya and Nagaland and the Deccan Peninsula is rich in endemic flora, with a large number of plants which are not found elsewhere.

India is rich in flora. Available data place India in the tenth position in the world and fourth in Asia in plant diversity. From about 70 per cent geographical area surveyed so far, 47,000 species of plants have been described by the Botanical Survey of India (BSI), Kolkata.



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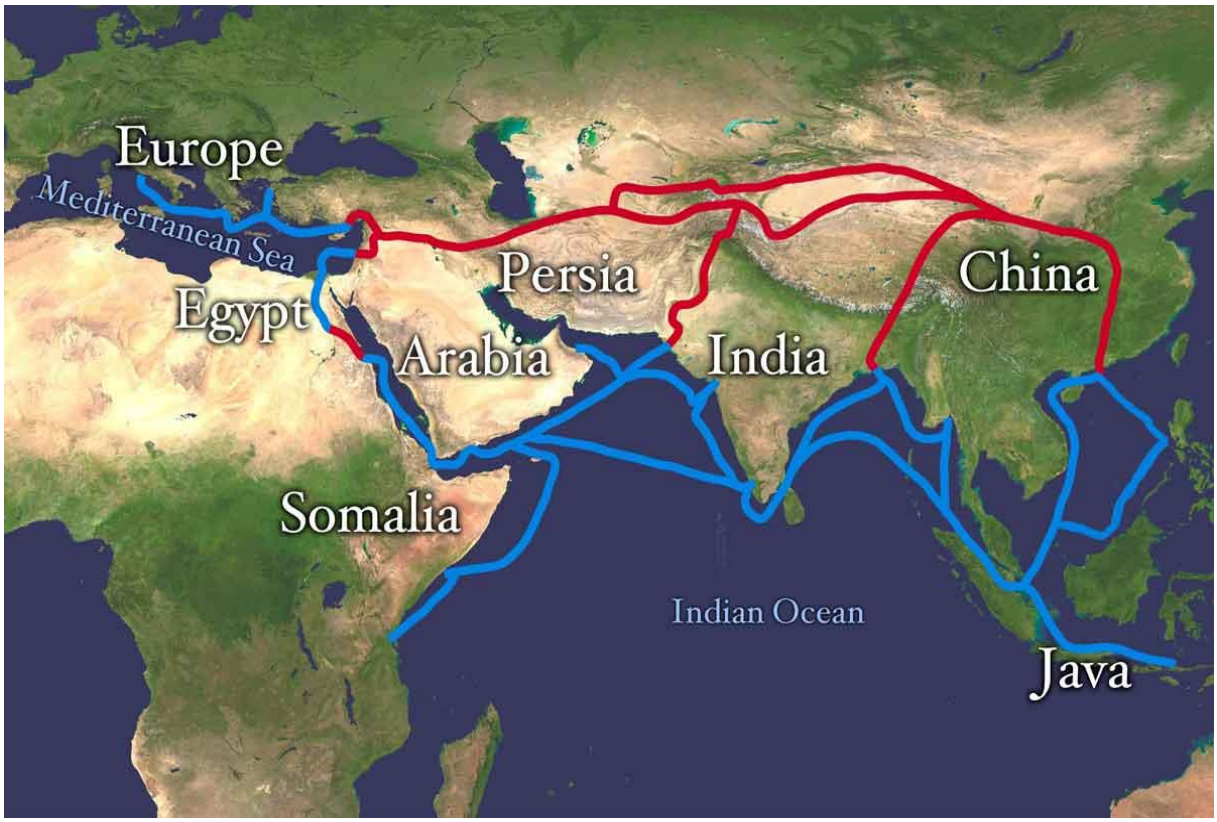
(ii) Impacts of Indian Ocean and Himalayas on the Culture and Civilization in India

India's history and culture is dynamic, spanning back to the beginning of human civilization. It begins with a mysterious culture along the Indus River and in farming communities in the southern lands of India. The history of India is punctuated by constant integration of migrating people with the diverse cultures that surround India. Available evidence suggests that the use of iron, copper and other metals was widely prevalent in the Indian sub-continent at a fairly early period, which is indicative of the progress that this part of the world had made. By the end of the fourth millennium BC, India had emerged as a region of highly developed civilization.

For thousands of years the Himalayas have held a profound significance for the peoples of South Asia, as their literature, mythologies, and religions reflect. Since ancient times the vast glaciated heights have attracted the attention of the pilgrim mountaineers of India, who coined the Sanskrit name Himalaya—from *hima* (“snow”) and *alaya* (“abode”)—for that great mountain system. In contemporary times the Himalayas have offered the greatest attraction and the greatest challenge to mountaineers throughout the world.



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The Indian Ocean region contains a variety of cultures and people varying from nomadic tribal peoples to highly technological urban communities. The vast geographic spread of the region, combined with the enormous spectrum of human activity within it, has obscured the fact that culturally and historically the lands of the Indian Ocean form a distinctive region.

From the earliest times the Indian Ocean has provided the ideal means of communication between the core areas of civilization along its shores. Maritime hazards may have been daunting, but had to be weighed against hostile terrains encountered during land migration. Many migrating peoples followed the land route but the Ocean was the route of the Austronesians, the Malays who settled in Madagascar, the Indo-Aryans and Dravidians who occupied Sri-Lanka and the Maldives, the Aboriginals who occupied the Andamans, Nicobars and Australia; and later groups such as Arabs, Indians, Africans and Europeans. The movement of peoples across the Indian Ocean, within and between core cultural areas, was one of the major agents' in the earliest forms of cultural interchange.

The process gained momentum with the discovery of the secrets of the Ocean (particularly the monsoon winds) and refined shipbuilding techniques, and a settled civilization developed and prompted the growth of trade within the Indian Ocean region. The process of human maritime expansion constantly intertwined with land-based migration of peoples on the littoral and both processes added to the growing complexity of the core cultures.