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OUR ECOSYSTEM





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Since 1957 A DEVELOPMENT MONTHLY

Let noble thoughts come to us from all sides.
Rig Veda

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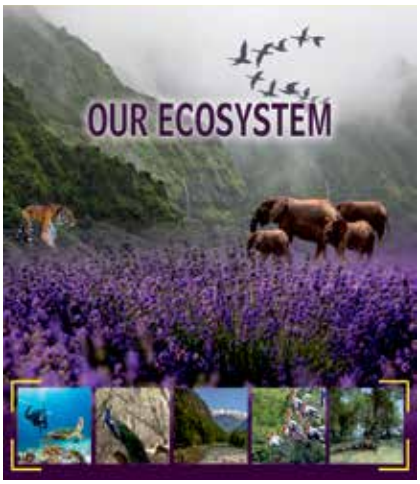
Let's Nurture Together



From the majestic Himalayan mountains to the expansive seacoasts; from the dense green forests of the northeast to the scorching deserts of the northwest; to various kinds of woods, marshes, islands, and oceans; India has a great diversity of natural ecosystems. With 80 Ramsar wetlands and over 40 UNESCO World Heritage sites, towering plateaus, lush river plains, and numerous large rivers, India has incredibly versatile topography and is a traveller's delight.

The Himalayas' lofty valleys, diverse array of flora and fauna, and high peaks have long drawn travellers, adventurers, and spiritual seekers, which ultimately impact the country's spiritual, artistic, and cultural fabric. Some of the world's tallest peaks, including Mount Everest, Kanchenjunga, Nanga Parbat, and others, are found in the Great Himalayas. Even if we are in awe of their grandeur, it is important to protect and preserve this natural wonder so that future generations might likewise be enthralled by the breathtaking splendour of the Himalayas.

The largest desert in India, the Thar Desert is situated in the northwest and is distinguished by its arid terrain and shifting sand dunes. The Aravalli Range's rain-shadow effect is what caused it to form. The Thar Desert is home to a wide range of desert-adapted wildlife, such as Indian gazelles, blackbuck antelopes, and desert foxes, despite its severe climate.

Spanning from the foothills of the Himalayas to the Thar Desert, the Indo-Gangetic Plain is a fertile alluvial plain formed by the deposition of sediments from the Himalayan Rivers. The Indian portion of the majestic Sundarban region is situated at the lowest point of the Ganga delta. The region with mangrove forests is renowned for its diverse array of wildlife, which includes several bird species, the Bengal tiger, and other endangered species like the Indian python and estuary crocodile.

The peninsular plateau, which stretches from India's centre to its south, covers the majority of the country's land area. It is a vast, rough, and high region crisscrossed by many major rivers, including the Narmada, Godavari, Krishna, and Kaveri, all of which are far older than the Himalayan rivers. The Western and Eastern Ghats, renowned for their exceptional biodiversity and stunning scenery, border the peninsular plateau and run parallel to India's western and eastern coasts. The Deccan Plateau is a large elevated region that spans a large chunk of central and southern India. It is distinguished by its fertile plains, volcanic structures, and flat-topped hills. The Gulf of Mannar, the Andaman and Nicobar Islands, and coral reefs themselves are hotspots for biodiversity that are home to an incredible array of marine life, including sea turtles, colourful fish, and coral polyps.

India's geological diversity is the foundation of its remarkable ecological richness. Ecosystem conservation and human well-being are closely interlinked. Ecosystems' long-term resilience and health is paramount for future generations because they uphold the values of sustainability, conservation, and respect for the natural world. The need to comprehend and protect our ecosystems is greater than ever as we work through the challenges of the 21st century. In this issue of Yojana, we delve into the diversity, resilience, and pressing need for conservation of ecosystem. Hope the insights from this issue will not only help our readers to explore the rich tapestry of India's ecosystem but also remind them of our collective responsibility to nurture and sustain the ecosystems that sustain us. ❑

GEOLOGICAL ECOSYSTEM

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India is the fifth largest country in the world and has rich geographical and geological diversity, ranging from the mighty Himalayas which are one of the highest mountain ranges in the world to low-lying coastal plains overseeing the vast Indian Ocean. Its geological terrain has rocks, ranging from the Achaean age, formed billions of years ago, at the beginning of the formation of Earth, to riverine alluvium deposited just a few thousand years back.

The geographical landscape of India is marked by the majestic Himalayas in the north which has played a significant role in the unique cultural evolution of the Indian subcontinent. To the south of the Himalayas, lies the vast alluvial tract formed by rivers originating from the Himalayas such as Ganga, Yamuna, Ravi, Sutlej, Gandak, Kosi, Tista, Brahmaputra, etc. The Ganga and Brahmaputra River systems are one of the most fertile regions in the world and are home to a significant portion of India's population. Most of India's geographical area is covered by peninsular plateau which extends from central to southern parts of the country. It is a large, elevated, rugged terrain dissected by numerous big rivers such as Narmada, Godavari, Krishna, and Kaveri which are much older than the Himalayan rivers. Bordering the peninsular plateau and running parallel to India's western and eastern coasts are the Western and Eastern Ghats, which are

Jim Corbett National Park

Kaziranga National Park

known for their rich and unique biodiversity and picturesque landscape. India has a long coastline of about 7,500 km, bordered by the Arabian Sea to the west, the Indian Ocean to the south, and the Bay of Bengal to the east. This coastline has fertile coastal plains, sandy beaches, rocky shores, and coastal wetlands, occupied by mangrove forests. The Thar Desert is located in the northwest part of India which is a vast arid region with rolling sand dunes, sparse vegetation, and distinctive fauna. India also has several island groups, the most prominent being the Andaman and Nicobar Islands in the Bay of Bengal and the Lakshadweep Islands in the Arabian Sea. These islands have rich marine biodiversity and are of great strategic importance to the country.

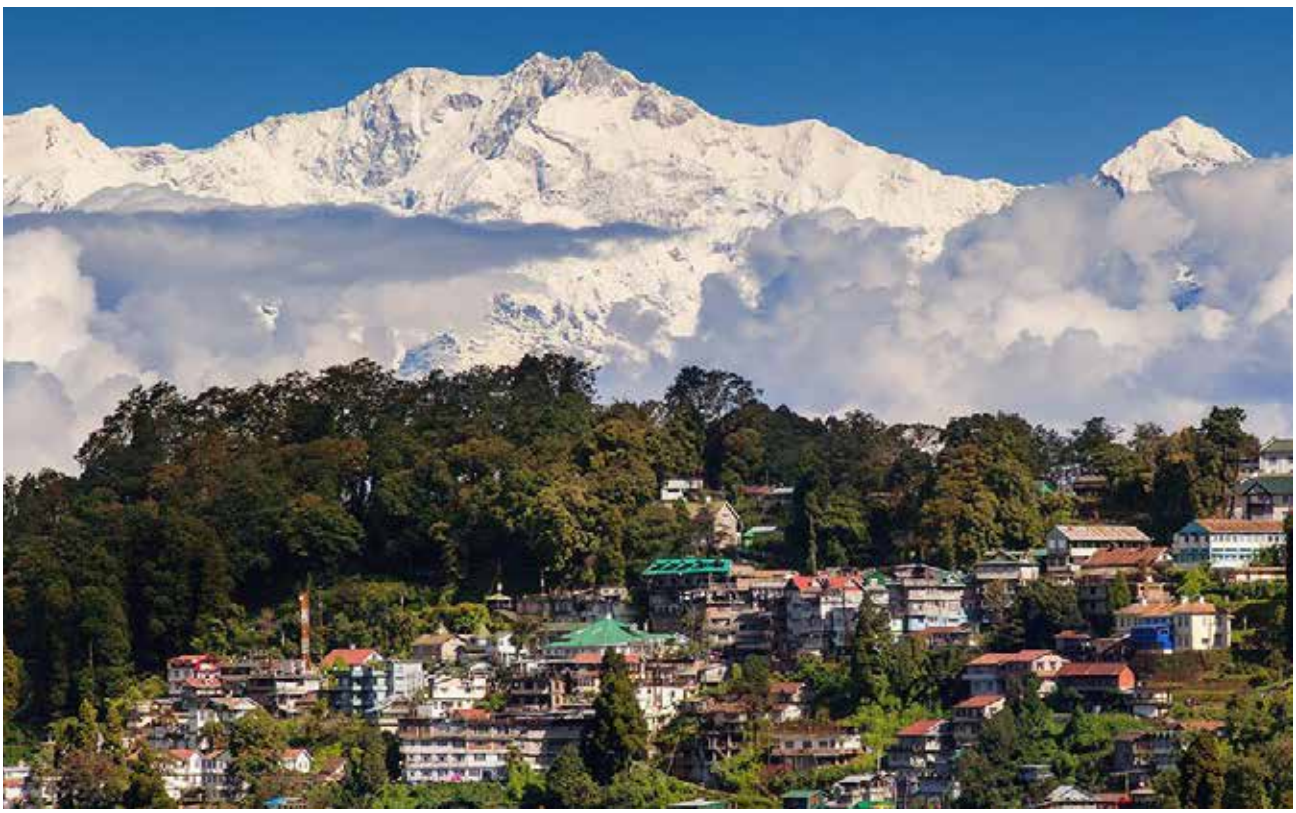
The Himalayas, the highest mountain range in the world, separates the Indian landmass from the Tibetan Plateau. It has been formed by the collision of the Indian plate with the Eurasian plate, resulting in the formation of a large fold mountain system, running along the northern fringes of the Indian sub-continent. It runs from west-northwest to east-southeast direction in the form of an arc for about 2,400 km, extending across five southeast Asian countries. Its width varies from 350 km in the west to 150 km in the east. The Himalayan terrain comprises high snow-clad peaks, deep valleys with steep-sided slopes, and glaciers. Physiographically, the Himalayas consist of four parallel mountain ranges namely, the Shivalik Hills, the Lower Himalayan Range or Himachal, the Great Himalayan Range or Himadri, and the Tibetan Himalayas from south to north. The Great Himalayas are home to some of the highest peaks in the world such as Mount Everest, Kanchenjunga, Nanga Parbat, etc. Several glaciers are present within the range, including Gangotri Glacier and Satopanth Glacier. The Himalayan glaciers are the source of fresh water for the rivers of northern India, providing water to the majority population of the country. The region is still geologically active, with potential for geothermal energy resources. Hot springs and geothermal anomalies have been identified in various areas, indicating the presence of subsurface heat sources that could be harnessed for power generation.

The **Northern Plains** also referred to as 'Great Plains of India', is one of the most extensive alluvial tracts in the world. It runs for roughly 2400 km from west to east and stretches 240 to 320 km from north to south. In some parts, the depth of the sediments is as much as 2000 to 3000 m. It has formed from sediments brought by rivers, originating from uplifting Himalayas, and deposited in a foreland basin. Though it has a low elevation with a general slope from northeast to southwest and south, there are some diverse relief features in the vast Northern Plains. As the rivers originating from the Himalayas descend the hills, their velocity decreases and as a result, they dump much of their denser and coarser sediment fraction along the foothills in a narrow, porous, thin strip called Bhabar which is around 8 to 16 km wide. The streams go underground in the Bhabar belt because of its porosity. The Terai belt is located south of the Bhabar belt where streams go underground in the Bhabar belt resurfaces. It is a poorly drained, wet, marshy, and densely forested narrow track, running parallel to Bhabar stretching for roughly 15-30 km. The densely forested Terai

region has diverse flora and fauna and houses some of the famous national parks such as Jim Corbett National Park in Uttarakhand and Kaziranga National Park in Assam. Another relief feature of the Northern plains is Bhangar, which is an older alluvium that forms a terrace above the floodplain. It is frequently covered in calcareous stone-like pebbles known as 'Kankar'. The flood plains along the riverbanks are formed by Khadar, which is made up of newer alluvium, replenished every year. The northern plains provide fertile alluvial soil which supports agricultural activities and sand is used as construction material for building purposes. The sand deposits of the plains are excellent aquifers that provide water for drinking and agriculture.

The rivers of northern plains are laden with sediment deposits, their sediment load at the mouth forms the largest delta in the world called **Sundarbans**. It is marked by a complex network of tidal waterways, mudflats, and small islands of salt-tolerant mangrove forests and presents an excellent example of ongoing ecological processes. The mangrove forest presents a natural barrier against tropical cyclones and tsunamis. The area is known for its wide range of fauna, including many bird species, the Bengal Tiger, and other threatened species such as the estuarine crocodile and the Indian Python.

The **Peninsular Plateau** is the largest physiographic entity of the Indian landmass. It has a table-land type of topography, marked by elevations of about 900-1200 m above mean sea level, dissected by numerous rivers, forming broad valleys. It presents a rugged terrain with residual hills, formed by weathering of mountain chains formed millions and billions of years ago. The plateau stretches from the Aravalli Range in the west to the Chota Nagpur Plateau in the east. It comprises important mountain ranges of Central India such as Vindhyans, Satpuras, Mahadeo, Maikal and Sarguja ranges as well as the Western and Eastern Ghats. It mainly comprises hard crystalline rocks of igneous and metamorphic origin. It is rich in mineral resources, which is critical for India's economic development. It contains mineral deposits, such as iron, bauxite, mica, gold, copper, manganese, etc. It is home to well-known mines like Kolar, Hutti, Bailadila, Singhbhum, Korba, Malanjkhand, etc. Most of the Gondwana coal deposits of India are found in the Peninsular Plateau. The region has



Mt. Kanchenjunga

Radhanagar Beach, Andaman and Nicobar Islands

abundant reserves of limestone which is a key raw material used in the cement industry. The Deccan basalts of the peninsular plateau are being quarried at many places to be used as road metal. The plateau also has deposits of various other mineral commodities such as chromite, lead, zinc, gypsum, etc. In addition to rich mineral resources, the region also supports ample crop production. A large part of the plateau is covered with fertile black soil which is extremely useful for growing cotton. Some low-hilly regions of peninsular India are suitable for the cultivation of crops like tea, coffee, rubber, etc. The fertile coastal plains formed from alluvium brought by rivers, draining peninsular India support agriculture in coastal areas. The beach sands of coastal areas are rich in thorium-bearing monazites which have the potential to power India's nuclear projects.

The **Thar Desert**, also known as the 'Great Indian Desert', is a vast arid region, located primarily in the northwestern part of the Indian subcontinent. It consists of sand dunes, rocky terrain, salt flats, and sparse vegetation. The sand dunes, known as 'bhakhar', can reach heights of up to 150 m and constantly shift with the wind. The desert also features dry riverbeds called 'nullahs', which occasionally fill with water during the monsoon season. Despite its harsh conditions, it supports a unique ecosystem with specialised plant and animal species adapted to desert life. The region is rich is oil reserves and is home to one of the largest onshore oil fields in India in Barmer Basin. The region also has one of the largest salt marshes in the world called the 'Great Rann of Kutch'. Kutch is one of the major salt-producing districts in India.

Lakshadweep Islands

India is surrounded by numerous islands, each with its own unique geographical, ecological, and cultural characteristics. The **Andaman and Nicobar Islands** form an archipelago, consisting of around 572 islands, out of which only about 37 are inhabited. These islands are known for their pristine beaches, lush tropical forests, and diverse marine life. These island chains are mainly volcanic in origin, formed by the eruption of lava due to plate movements. Barren Island in the Andaman Sea is the only active volcano in India. Episodic lava flows are responsible for the highly rugged terrain of the island. Another prominent group of islands from the west coast of India is **Lakshadweep**, which is an archipelago of 36 islands. These are mainly coral islands with unique marine flora and fauna. The Andaman & Nicobar and Lakshadweep islands are also tourist hotspots of India, fostering the tourism industry in India.

India is endowed with great mineral wealth and is one the largest producers of coal, iron ore, bauxite, manganese, mica, and zinc in the world. Geological ecosystems have not only played a major role in defining India's mineral wealth but also have shaped its unique geographical landscape. ❑

FROM PEAKS TO VALLEYS: A HOLISTIC EXPLORATION OF THE WESTERN GHATS

Nestled along the western coast of India lies a natural wonder of unparalleled beauty and ecological significance: the Western Ghats. Spanning over 1,600 kilometers and covering an area of approximately 140,000 square kilometers, this ancient mountain range is not merely a geographical feature but a cradle of life, harbouring an astonishing array of flora, fauna, and cultural diversity.

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The Western Ghats are recognised as a global biodiversity hotspot and often referred to as the Great Escarpment of India, also holding the prestigious designation of a UNESCO World Heritage Site. The Western Ghats, also known as the Sahyadri Mountain Range, stretch from a latitudinal extent of 8°–22°N from the river Tapti in the north to Kanyakumari in the South. It encompasses regions in six States: Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu, and one Union Territory (Dadra & Nagar Haveli).

Topography and Natural Resources

The Western Ghats hold significant importance from several perspectives. One of its significant aspects is that its geomorphic value belongs to the Malabar Rainforest Biogeographic Province. Their positioning makes the Western Ghats biogeographically distinct and exceptionally biodiverse—a valuable repository of biological wealth. The Western Ghats are older than the Himalayas and hold the distinction of being an 'evolutionary ecotone,' providing evidence for both the 'Out of Africa' and the 'Out of India' hypotheses.

Renowned for their breathtaking topography, characterised by steep cliffs, undulating hills, deep valleys, and expansive plateaus, these mountains took shape millions of years ago during the collision of the Indian subcontinent with the Eurasian plate.

As a result of this collision, the land was thrust upward, giving rise to the majestic mountains of the Western Ghats. These mountains hold significant importance in the Indian landscape, serving as vital habitats for diverse plant and animal species while also contributing to climate regulation. The Western Ghats have an average elevation of around 1,200 metres (3,900 ft), with several peaks reaching heights of up to 2,600 metres (8,500 ft). Anamudi, located in Kerala, is the highest peak in the Western Ghats. The Western Ghats can be subdivided into three primary parts:

i. **The Northern Ghats:** The area extends from Gujarat to Maharashtra and represents the lowest and least rugged section of the Western Ghats.

ii. **The Central Ghats:** They extend from Karnataka to Kerala and represent the highest and most rugged section of the Western Ghats.

iii. **The Southern Ghats:** The area extends from Kerala to Tamil Nadu and represents the most dissected section of the Western Ghats.

The Western Ghats, spanning a vast expanse, are identified by a multitude of local names, reflecting the diverse languages and cultures of the region. Some of these unique names are:

i. **Sahyadri**: The meaning of Sahyadri is 'the abode of Sahya' (a mythological rain serpent), also known as the 'benevolent mountain' due to its verdant landscapes. This range stretches from Gujarat in the north to Maharashtra and Karnataka in the south.

ii. **Nilgiri Hills**: Signifying 'blue mountains', this name is attributed to the southernmost section of the Western Ghats, located at the junction of Karnataka, Kerala, and Tamil Nadu.

iii. **Sahya Parvatam**: In Malayalam, this term translates to 'Sahya Mountains' and is commonly used in Kerala, particularly in the southern reaches of the range.

iv. **Cardamom Hills**: Located on the Kerala-Tamil Nadu border, these hills derive their name from the cardamom plant, a prominent spice cultivated in the region.

v. **Anaimalai Hills**: Situated in the southern reaches of the Western Ghats along the Kerala-Tamil Nadu border, these hills derive their name from the Tamil word 'aanai,' meaning 'elephant,' symbolising the presence of wild elephants in the region.

These are just some of the many mountain ranges that make up the Western Ghats. Understanding these local names of mountains not only enriches our appreciation of the cultural significance of the Western Ghats but also underscores the profound connection various communities hold with this majestic mountain range.

The Western Ghats are abundant in natural resources that sustain both ecosystems and human communities. The region is a watershed for several major rivers, including the Godavari, Krishna, Kaveri, and Tungabhadra, which provide water for irrigation, drinking, and hydropower generation to millions of people. These mountains play a pivotal role in modulating India's climate by intercepting monsoon winds, preventing them from reaching the Deccan Plateau, and thus maintaining its

Grass Hills of Akkamalai

Gira Waterfall in Western Ghats of Gujarat

Saputara in Western Ghats of Gujarat

cool, dry conditions. Furthermore, the Ghats exert a significant influence on the ecological and biophysical processes throughout the entire Indian peninsula, shaping monsoon weather patterns across the country and exemplifying the tropical monsoon system. Acting as a natural barrier against rain-laden southwest monsoon winds during late summer, the Western Ghats perform crucial

Table 1: The dominant vegetation types of Western Ghats

Vegetation type	Elevation	Rainfall	Dominant flora
Tropical evergreen forest (west slopes)	200-1,500m	2,500-5,000mm	Emergents up to 60m; *Acrocarpus, Aglaia, Artocarpus, Calophyllum, Canarium, Cullenia, Dipterocarpus, Holigarna, Knema, Myristica*
Moist deciduous forest (most on high east slopes)	500-900m	2,500-3,500mm	*Bridelia, Pterocarpus, Sterculia, Tectona, Pterospermum, Lagerstroemia, Terminalia*
Dry deciduous Buchanania (east slopes)	300-900m	1000-2000mm	*Albizia, Anogeissus, Bauhinia, Butea, Dillenia, Emblica*
Scrub	200-500m	300-600mm	*Acacia, Carissa, Capparis, Flacourtia, Gardenia*
Shola	Above 1,500m	Medium to high	Short trees 15-20m: *Actinodaphne, Elaeocarpus, Euonymus, Michelia, Rhodomyrtus, Schefflera, Symplocos*
Grassland	1,700-1900m	Medium to high	Grasses: *Chrysopogon, Arundinella, Eulalia, Heteropogon*
Montane grassland	Montane	Very high	Herbaceous to shrubby cover: *Ligustrum, Rhododendron, Anaphalis, Strobilanthes*
Peat bog	<2000m	High	Grasses, sedges and mosses: *Carex, Cyanotis, Cyperus, Eriocaulon*
Myristica swamp	0 m to 600m	Medium to high	*Myristica, Knema, Hydnocarpus, Lophopetalum*

Source: World Heritage Datasheet

hydrological and watershed functions. It is reported that approximately 245 million people living in the peninsular Indian states depend substantially on water from rivers that originate in the Western Ghats, emphasising the crucial importance of this region's water and soil for sustaining the livelihoods of millions. Furthermore, the region is abundant in mineral resources such as iron ore, manganese, bauxite, limestone, and others.

Biodiversity

The Western Ghats, owing to their extensive length and geographical coverage, boast a rich and diverse biodiversity. It harbours one of the highest levels of endemism globally. Nair and Daniel, 1986, documented a total of 4,000 vascular plant species, of which 1,500 were endemic, accounting for 37.5% of the total. Specifically, of the nearly 650 tree species identified in the Western Ghats, 352 (54%) are found nowhere else. Animal diversity is equally remarkable, with amphibians (up to 179 species, 65% endemic), reptiles (157 species, 62% endemic), and fishes (219 species, 53% endemic), highlighting high levels of endemism. While invertebrate biodiversity, though not fully explored, is anticipated to be substantial, with approximately 80% of tiger beetles considered endemic.

The climatic and altitudinal gradient of the Western Ghats has led to a diverse range of vegetation types, including evergreen, semi-evergreen, moist deciduous, and dry deciduous vegetation. Based on ecological characteristics and plant composition, the Western Ghats region encompasses four major forest types and 23 different forest subtypes. The climatic and altitudinal gradient has led to a diverse range of plant types, including evergreen, semi-evergreen, moist deciduous, and dry deciduous forms. Briefly, the Western Ghats have the following forest types, (i) dry scrub vegetation (ii) dry deciduous forests (iii) moist deciduous forests (iv) semi evergreen forests (v) evergreen forests (vi) shoals; and (vii) high-altitude grasslands. Each of these forest types encompasses numerous subtypes, formations, or associations, highlighting a diverse range of floral compositions.

The Western Ghats stand out as one of India's key regions characterised by tropical evergreen forests, boasting immense plant diversity. Various researchers, including Gamble (1915-1936), Fyson (1932), Rao (1984), Nayar (1980, 1982 &1996), Mathew (1981-1984) Mohanan and Sivadasan (2002), and numerous others, have extensively documented the rich floristic diversity of this region. Moreover, several State and District floras have underscored the diversity and abundance of flora found here. It is estimated that approximately 12,000 species, ranging from lower groups to flowering plants are estimated to occur in this area. Among them, around 2,100 species are endemic flowering plants, out of a total of 5,800 flowering plant species in this highly endemic region. This represents roughly 27% of India's total flora. The floral species found in the Western Ghats shares a striking resemblance to the flora of Eastern Africa, Malaysia, and Sri Lanka. This floral affinity suggests a connection between the Western Ghats and the ancient landmass of Gondwana, which comprised South America, Madagascar, India, and the islands of Malaysia, Sri Lanka, Australia, and Antarctica. The historical linkage of peninsular India with these surrounding continents explains the distribution of certain genera such as *Hernandia, Lindenbergia, Pittosporum,Acrotrema,Gomphandra,Nothopodytes, Sarcostigma, Hydnocarpus*, and others across the Western Ghats, Africa, and even parts of South America. In India alone, there are approximately 1230 orchid species, with over 300 expected to be found in the Western Ghats. Notable ornamental species in this region include *Acanthephippium bicolor, Pecteilisgigantea, Rhynchostylisretusa, various species of Vanda, Dendrobium, Aerides, Eulophia*, and *Paphiopedilumdruryi*. However, ongoing exploration in the Western Ghats continually unveils new orchid taxa and reports, indicating the necessity for further investigation in various under-explored regions.

The Western Ghats boast an exceptional diversity of fauna, making them one of the world's biodiversity hotspots. The Western Ghats are home to a minimum of 325 species listed as globally threatened according to the IUCN Red List. This includes 229 plant species, 31 mammal species, 15 bird species, 43 amphibian species, 5 reptile species, and 1 fish species. Among these globally threatened species, 129 are categorised as vulnerable, 145 as endangered, and 51 as critically endangered. The Western Ghats are home to several flagship mammal species, including significant populations of globally threatened species such as the Asian

Elephant, Gaur, and Tiger. Additionally, the region hosts endangered species like the lion-tailed Macaque, Nilgiri Tahr, and Nilgiri Langur, which are unique to the area. Moreover, the Western Ghats play a critical role in conserving various threatened habitats, such as distinctive seasonally mass-flowering wildflower meadows, Shola forests, and Myristica swamps. Here's a glimpse into some of the fascinating fauna groups found in the Western Ghats:

Mammals: The Western Ghats are home to 139 mammal species, with 16 of them being endemic. Among the most threatened species are the Nilgiri Tahr, Lion-tailed Macaque, Gaur, Tiger, Asian Elephant, Sloth Bears, Nilgiri Langur, Indian Leopard, and Nilgiri Marten. The Malabar large-spotted civet is critically endangered.

Birds: There are 508 bird species in the Western Ghats, including 16 endemics. Notable species attracting ornithologists worldwide include the Broad-Tailed Grassbird, Nilgiri Wood Pigeon, Nilgiri Pipit, Black, Rufous-Breasted Laughing Thrush, Rufous Flycatcher, Crimson-Backed Sunbird, Malabar Grey Hornbill, and Grey-Headed Bulbul (Pujar, 2022).

Reptiles: Approximately 124 reptile species inhabit the Western Ghats, with Melanophidium, Teretrurus, Plecturus, and Rhabdops being common endemic shield-tailed snakes. Endemic venomous snakes include the Malabar pit viper, striped coral snakes, and the horseshoe pit viper.

Amphibians: Nearly 80% of amphibian species in the Western Ghats are endemic. Endemic frogs include the Malabar frog, Micrixalus, and Indirana, while Mercurana, Ghatixalus, and Beddomixalus are among the endemic tree frogs. Ghatophryne and Pedostibes are endemic toads.

Fish: The Western Ghats are home to over 288 freshwater and 35 marine fish species, with 118 being endemic. Of the freshwater species, 97 are threatened, with 12 critically endangered, 31 vulnerable, and 54 endangered.

Invertebrates: Over 331 butterfly species and 174 dragonfly species can be found in the Western Ghats, with 69 dragonflies being endemic.

Indigenous Knowledge System

The indigenous communities residing in the Western Ghats possess a vast knowledge of medicinal plants and their properties, accumulated over generations. This knowledge, often passed down orally through storytelling and practices, is crucial for their well-being and cultural identity. Several documented instances highlight the rich medicinal knowledge of the Western Ghats' indigenous communities.

For instance, the Kani tribe, an indigenous community living in the Agasthyamalai hills of the Western Ghats in Kerala, has been utilising the Arogyapacha (*Trichopuszeylanicus*) plant since the 1980s. The Kani tribe used the plant in an herbal remedy known as Jeevani.

The term arogyapacha literally refers to 'the green that gives strength.' The Kani tribe is aware of the plant's anti-fatigue benefits and consumes it during long treks in the Western Ghats. Research has found that the plant possesses anti-stress and immune-boosting characteristics, and can aid in improving endurance, combating tumours, and enhancing cellular immunity. *T. zeylanicus* attracted global attention due to being the first to use a benefit-sharing strategy with tribals for commercialisation. In 1994, the Jawaharlal Nehru Tropical Botanic Garden & Research Institute in Kerala filed a patent application with the Office of the Controller General of Patents, Designs, and Trademarks of India (IP India) for an herbal sports

Arogyapacha (Trichopuszeylanicus)

Traditional medicine practitioner locally-known as Bhagat in Valsad, Western Ghats of Gujarat

medicine based on compounds derived from the plant. The formula was developed into a commercial enterprise, and the tribe's Kerala Kani Welfare Trust receives licence fees and royalties.

Indigenous people of Valsad district, located in the Western Ghats of Gujarat, still use a large range of herbal medicines prescribed by traditional practitioners known locally as Bhagats in the treatment of various human and veterinary diseases.

The Soligas have been residing in a wildlife reserve in the Biligiri Hills of Karnataka among tigers and elephants for centuries. The narratives and principles of this group are valuable for rethinking conservation practices. The Soligas have learned to live peacefully with wildlife by using traditional methods passed down through generations. They can tell when it will rain by listening to bird calls and watching their flight patterns. They also know how to stay safe around tigers and elephants by recognising their behaviour and sounds. By respecting and worshipping plants and animals, they help keep the environment balanced and healthy. The Soligas take care of the forest and reserve some resources for the animals. For instance, they don't gather all the honey; they leave some for the animals.

It's essential to pass on the Soligas' knowledge to future generations and to learn from their experiences. This knowledge can help forest managers and conservationists better understand how to protect nature while also managing conflicts between people and wildlife. The Soligas' way of managing the Biligiri region provides the general public with a number of significant ecosystem services, including clean, fresh air and water to the densely populated areas nearby, sequestration of CO_2 and mitigation of climate change, and suppression of wildfires and soil erosion to safeguard the downstream cropping areas.

Their peaceful coexistence with wildlife shows us the importance of including traditional knowledge from tribal communities in our conservation efforts. The Soligas consider themselves part of nature and worship animals like tigers, elephants, and even trees and stones. This deep connection with the environment is evident in the beautiful landscape of the Biligiri Hills (https://www.iucn.org/news).

The mountain region's unique culture belongs to the Adivasi indigenous tribal people, whose traditional way of life is in danger. Several ancient dolmens, caves adorned with cave paintings, and megalithic burial sites can still be found in Chinnar. Additionally, Srivilliputtur Sanctuary boasts seven popular temples, while others in Agasthyamalai, Periyar, Talacauvery, and Someshwara attract numerous pilgrims. Notably, Ganga Moola in Kudremukh is revered as the source of three great rivers. Among the mountains, there are approximately 2,000 sacred groves (World Heritage Datasheet).

Threats

Despite their profound ecological importance, the Western Ghats are confronted with numerous threats that jeopardise their unique biodiversity and ecosystem services. Among the major concerns is habitat loss and fragmentation, primarily driven by the cultivation of coffee, tea, palm, rubber, and other crops, leading to widespread deforestation. The continuous depletion of forests renders the biodiversity of the region increasingly vulnerable, as flora and fauna lose their natural habitats to expanding urbanisation and industrial development.

Wildlife poaching, deforestation, overfishing, and livestock grazing further exacerbate the destruction of nature, causing irreparable harm to forest and aquatic ecosystems. Additionally,

the excessive use of agrochemicals in various plantations contributes to the deterioration of natural habitats. Moreover, the construction of railway lines, mining operations, and tourist infrastructure in the mountainous areas disrupts the delicate balance of natural harmony, posing additional threats to the Western Ghats' ecological integrity.

Conservation and Management

Through a robust legal framework, including laws such as the Environment (Protection) Act, Wildlife (Protection) Act, and Forest Rights Act, declaration of Eco-Sensitive Zone (ESZ) etc., efforts have been made to provide legal protection to wildlife and habitats, designate protected areas, and recognise the rights of forest-dwelling communities. Institutions and agencies like the Ministry of Environment, Forests, and Climate Change, State Forest Departments, and the National Biodiversity Authority play pivotal roles in overseeing conservation efforts across the Western Ghats. Specific initiatives have been undertaken, such as expanding the protected area network, implementing Project Tiger for tiger conservation, and launching national missions like the Green India Mission and the National River Conservation Plan. However, challenges persist, including the effective implementation of policies, balancing development with conservation, ensuring inter-state coordination, and addressing emerging climate change issues. Looking ahead, priorities include strengthening enforcement mechanisms, promoting sustainable development practices, enhancing collaboration among stakeholders, investing in research and monitoring, and addressing the challenges posed by climate change. Collaboration among the Government, local communities, NGOs, and other stakeholders remains crucial for the successful conservation of the Western Ghats. ❑

References

1. Fyson, P.F., (1932). The Flora of South Indian Hill stations. Madras Govt. Press, 2 vols.
2. Gamble, J.S. (&C.E.C. Fischer) (1915-36). Flora of the Presidency of Madras, Adlard& Son Ltd. London.
3. GEER (Gujarat Ecological Education and Research Foundation), (2005). Medicinal Plants of Gujarat, pp. 410
4. https://mssbg.mssrf.org/
5. https://roundglasssustain.com/
6. https://whc.unesco.org/
7. https://www.animalia.bio/
8. https://www.downtoearth.org.in/
9. iisc.ac.in: Floristic Diversity in Western Ghats: Documentation, Conservation and Bioprospection– A Priority Agenda for Action
10. Mathew, K. M. (1981-84). The Flora of Tamil Nadu Carnatic, 3 vols. Rapinat Herbarium, Tiruchirapalli.
11. Mohanan, M. & M. Sivadasan. 2002. Flora of Agasthyamala, BSI, Calcutta.
12. Nair, N. & Daniel, P. (1986). The floristic diversity of the Western Ghats and its conservation: a review. Proc. Indian Acad. Sci. (Animal Sci./Plant Sci.) Suppl. pp.127-163.
13. Nair, N.C. & Henry, A.N., (1983). Flora of Tamil Nadu, India, series 1: Analysis. Botanical Survey of India, Coimbatore
14. Nayar, M.P., (1996). Hot spots of endemic plants of India, Nepal and Bhutan. TBGRI, Thiruvananthapuram.
15. Nayar, M.P., (1980). Endesim and patterns of distribution of endemic genera . J. Econ.Taxon. Bot.1: 99- 110.
16. Nayar, M.P., (1982). Endemic flora of peninsular India and its significance Bull. Bot. Surv. India 22: 12-23.
17. Pascal, J.P., (1982). Forest map of south India – sheet: Mercara-Mysore. Published by Karnataka & Kerala forest Departments and the French Institute, Pondicherry
18. Pascal, J.P., (1991). Floristic composition and distribution of Evergreen forests in the Western Ghats, India. Paalaeobotanist 39: 110-126.
19. Pujar, C. N., (2022). Exploring the Ecological Significance of the Western Ghats: A Geographical Study. Journal of Emerging Technologies and Innovative Research, Vol. 9 (8), 57-64
20. Pushpangadan P., George V., Parambilljinu T., and AmbikaChithra M., (2018). Biodiversity, Bioprospecting, Traditional Knowledge, Sustainable Development and Value Added Products: A Review. Journal of Traditional Medicine & Clinical Naturopathy 07: 1–7. 10.4172/2573-4555.1000256
21. Ramesh, B.R. De Franceschi, D & J.P. Pascal, (1997). Forest map of south India – sheet Tirulelveli, Published by Kerala and Tamil Nadu Forest Departments & French Institute, Pondicherry.
22. Rao, R. R., (1984). Biodiversity in India: floristic aspects. Bishen Singh & Mahendra Pal Singh, Dehra Dun.
23. Reddy, C. S., Jha, C. S., & Dadhwal, V. K. (2016). Assessment and monitoring of long-term forest cover changes (1920–2013) in Western Ghats biodiversity hotspot. *Journal of Earth System Science*, *125*, 103-114.
24. Vadakkemukadiyil Chellappan, B., Pr, S., Vijayan, S., Rajan, V. S., Sasi, A., & Nair, A. S. (2019). High quality draft genome of Arogyapacha (Trichopuszeylanicus), an important medicinal plant endemic to Western Ghats of India. *G3: Genes, Genomes, Genetics*, *9*(8), 2395-2404.
25. World Heritage Datasheet: https://www.yichuans.me/datasheet/output/site/western-ghats/
26. Yoganarasimhan, S.N., (2000). Medicinal Plants of India, Vol .2, Tamil Nadu, R. R. I, Bangalore.

SOIL ECOSYSTEM
A COMPLEX WEB OF LIFE

The soil ecosystem is a dynamic and diverse community of organisms and abiotic factors that sustain life on Earth. From nutrient cycling to habitat support, soil plays a vital role in terrestrial ecosystems and human well-being. The components and functions of the soil ecosystem are interconnected through intricate networks of relationships and feedback loops.

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The soil ecosystem is a remarkable and complex network of organisms and abiotic factors that interact in a dynamic environment beneath our feet. From microscopic bacteria to burrowing mammals, soils support a diverse array of life forms, playing a critical role in sustaining terrestrial ecosystems and human societies alike. In this article, we will explore the components and functions of the soil ecosystem, highlighting its significance and interconnections.

Components of the Soil Ecosystem

1. **Physical Environment:** The physical properties of soil, including texture, structure, and moisture content, create the foundation for the soil ecosystem. These factors influence the distribution and behaviour of organisms within the soil profile.
2. **Organic Matter**: Dead plant and animal material, along with living organisms such as microbes,

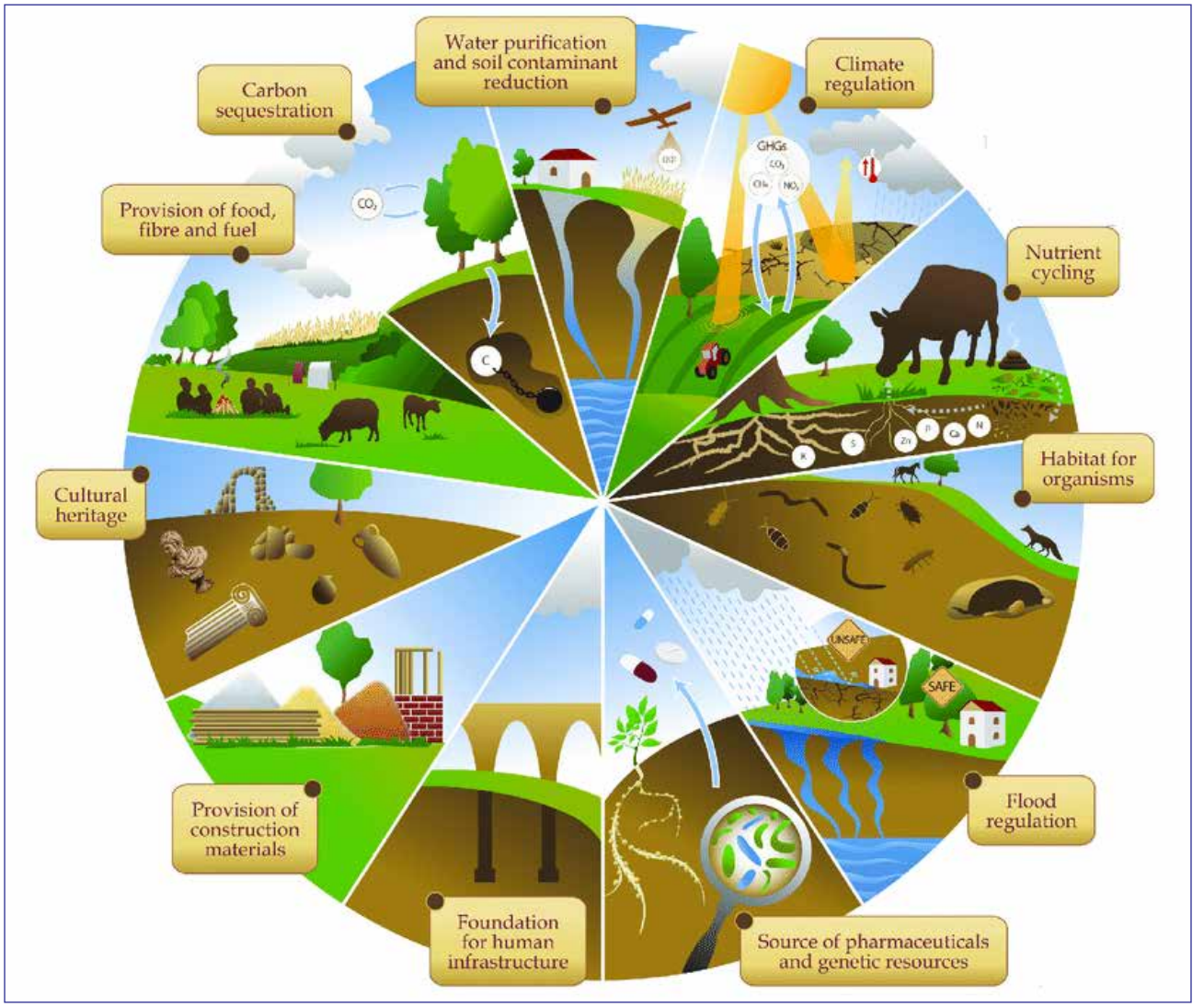

Figure 1: Schematic diagram of soil functions

fungi, and earthworms, comprise the organic component of soil. Organic matter provides nutrients and energy to support soil life and plays a crucial role in soil fertility and structure.

3. **Microorganisms:** Bacteria, fungi, protozoa, and other microorganisms are abundant in soil and are vital for nutrient cycling, decomposition, and soil health. They break down organic matter, fix nitrogen, and contribute to the formation of soil aggregates.
4. **Macroorganisms:** Larger organisms, including earthworms, insects, nematodes, and small mammals, inhabit the soil and play various roles in nutrient cycling, soil aeration, and soil structure formation. Their activities influence soil fertility and ecosystem functioning.
5. **Plant Roots:** Plant roots penetrate the soil, anchoring plants and absorbing water and nutrients. Root exudates fuel microbial activity and contribute to soil organic matter, shaping soil microbial communities and nutrient cycling processes.

Functions of the Soil Ecosystem

1. **Nutrient Cycling:** Soil organisms decompose organic matter, releasing nutrients such as nitrogen, phosphorus, and potassium into the soil. These nutrients are then taken up by plants, fuelling growth and productivity.
2. **Decomposition:** Microorganisms and detritivores break down organic matter, recycling nutrients and returning them to the soil. Decomposition processes

contribute to soil fertility and organic matter accumulation.

3. **Soil Formation:** Through weathering and biological processes, soil develops over time from parent material. Soil organisms, especially earthworms and soil microorganisms, play a key role in soil formation by mixing and transforming soil materials.
4. **Water Regulation:** Soil acts as a reservoir for water, storing and releasing it slowly over time. Soil structure and organic matter content influence water infiltration, retention, and drainage, affecting plant growth, groundwater recharge, and flood mitigation.
5. **Habitat Support:** Soil provides a habitat for a vast array of organisms, ranging from microscopic bacteria to larger mammals. Soil structure and organic matter content determine habitat quality and support biodiversity within terrestrial ecosystems.

Interconnections in the Soil Ecosystem

The components and functions of the soil ecosystem are interconnected through intricate networks of relationships and feedback loops. For example, plant roots exude sugars and other compounds, fuelling the growth of soil microbes. In return, microbes aid in nutrient uptake by plants and contribute to soil aggregation and structure formation. Similarly, earthworms ingest soil organic matter and mineral particles, mixing and enriching the soil as they move through it. A schematic diagram of soil functions is given in Figure 1, which shows all the components of the soil system.

Conclusion

The soil ecosystem is a dynamic and diverse community of organisms and abiotic factors that sustain life on Earth. From nutrient cycling to habitat support, soil plays a vital role in terrestrial ecosystems and human well-being. Understanding the complexity of the soil ecosystem is essential for sustainable land management and ecosystem conservation, ensuring the continued health and productivity of soils for future generations. ❑

SACRED GROVES

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"Very little has been published regarding sacred groves in India, but they are, or rather were, very numerous...these...as a rule, are not touched by the axe, except when wood is wanted for the repair of religious buildings."

– D Brandis (1887)
First Inspector General of Forest of India

The Rig Veda, (1700-1100 BCE) an ancient collection of Hindu hymns, mentions tree worship, which might be linked to the concept of sacred groves. Generally, Sacred groves are small forest patches conserved by local people through religious beliefs, traditional sentiments, and taboos (Ramakrishna 1997) and are repositories of many threatened species; they are popularly called living biological heritage sites as they contain rich diversity. The existence of sacred groves took place all over the world, including in India as well as in Asia, Africa, Europe, Australia, and America (Hughes and Chandra, 1998) It is estimated that the total number of sacred groves in India is likely to be more than 1.5 lakh (Malhotra *et al*. 2001). However, 14000+ sacred groves have been enumerated in different states. They have different vernacular names in rural and tribal areas. For example, in Sikkim popularly known as 'Gumpas'; Kave in kerala; Orans

in Rajasthan. Andhra Pradesh and Telangana Popularly known as 'Pavitra Vanalu/Rakshita Vanalu /Devata Vanalu'.

Types of Sacred Groves

Based on the deities, cultural, and the religious importance, and their association.

1. **Temple Groves:** These groves are associated with temples due to their religious importance; generally, they are protected by the government, the temple trust, or village committees. They often contain a wide variety of plants and animals. Examples: Ficus, Neem, and Tamarind tree.
2. **Traditional Sacred Groves:** These are the places where the folk deities reside, i.e., Potharaju, Yellamma, Polamma, Maridimma in Andhra Pradesh, Sammakka-Sarakka Grama Devathalu in Telangana, Kavus in Kerala, Gumpa Groves in Sikkim, etc. They often contain a rich variety of plant and animal life.
3. **Religious Groves:** Where they are associated with Hinduism, Buddhism, Jainism, Islamism, and Sikhism. Traditionally, these are protected by local communities through religious beliefs and customs, rather than by formal government legislation.
4. **Island Groves:** Island groves can be categorised based on the habitat type-specific ecological importance, for example, mangroves and coastal/reverie areas in Andhra Pradesh.
5. **Burial/Cremational/Memorial Groves:** Groves associated with burial places are popularly called Cremational/Memorial groves. Those groves are seen as places of reverence for the deceased and are believed to be inhabited by the spirits of ancestors. They may serve a spiritual or religious purpose, protected as a way to honour the dead and maintain a connection with them. For example, in Deherze village of Vikramgad Taluka in Thane district, there were over 85 stones dedicated to family members of the villagers.

Significance of Sacred Groves

1. **Protection of Ecosystems:** Sacred groves often serve as protected areas, safeguarding biodiversity by restricting human activities that can harm the environment.
2. **Traditional Knowledge:** Local communities that manage sacred groves often possess a deep understanding of the local ecology and traditional practices that have been passed down through generations. This knowledge can be valuable for informing conservation efforts for future generations.
3. **Biodiversity Conservation:** Sacred groves can act as refuge for a wide range of plant and animal species, especially in areas where habitat loss is a major threat. Biodiversity conservation practices associated with sacred groves often lead to sustainable management of natural resources and the maintenance of biodiversity.
4. **Cultural Preservation:** Sacred groves are important repositories of cultural and religious practices of local communities. They are often seen as the dwelling places of deities or spirits, and are used for religious ceremonies and rituals.
5. **Community Empowerment:** Sacred groves are often managed by local communities. Supporting the conservation of these areas can help to empower these communities and give them a greater role in decision-making about their natural resources.
6. **Environmental Benefits:** They play a vital role in maintaining the ecological balance of an area. The trees and other vegetation in sacred

S. No.	Name of the State	Sacred Grove Local Name	Number of Sacred Groves
1	Andhra Pradesh	Pavithra vanalu	713
2	Arunachal Pradesh	Gumpa forest	65
3	Assam	Than, Madaico	40
4	Bihar	Sarnas	43
5	Chhattisgarh	Sarna, Devlas, Mandar, Budhadev	600+
6	Goa	Deorai, Pann	93
7	Gujarat	Sabarkantha, Dahod and Banaskantha	29
8	Haryana	Beed or Bid, Bani, Janglat, Shamlat	248
9	Himachal Pradesh	Deobhumi	5000
10	Jammu and Kashmir	Kheer Bhawani	131
11	Jharkhand	Sarna, Jaherthan	21
12	Karnataka	Devarakadu, Devkad	1424
13	Kerala	Kavu, Sarpakavu	2000
14	Madhya Pradesh	Sharana, Devkot, Matikot, Devsthali, Bhdhadev	170
15	Maharashtra	Deorai, Devarai	1600
16	Manipur	Gamkhap, Mauhak	365
17	Meghalaya	Law kyntang, Law lyngdoh	125
18	Mizoram	Ngawpui	
19	Orissa	Jahera, Thakuramma	322+
20	Punjab	Chatpat Bani.	
21	Rajasthan	Oran, kenkri, Vani, Shamlatdeh, Devbani, Jogmaya	9+
22	Sikkim	Gumpa forest	56
23	Tamil Nadu	Kovilkadu	503
24	Telangana	Rakshita vanalu	65
25	Tripura	Gamkhap and Mauhak	166
26	Uttar Pradesh	Dev van, Just van	32
27	Uttarakhand	Deo bhumi, Bugyal	18+
28	West Bengal	Gramthan, Haritan, Sabitritan, Jahera, Deo Tasara and Mawmund	670+

Source: Murugesan, Amirthalingam(2016). Sacred Groves of India.10.20546/ijcrbp.2016.304.011

groves help to prevent soil erosion and provide clean air.

7. **Community Conservation:** The core principle of community conservation is protecting biodiversity, preserving natural resources, and managing natural resources sustainably for future preservation. It can also lead to a number of other benefits, such as improved livelihoods for local communities, increased food security, and enhanced cultural preservation.

Biodiversity Heritage Site

Biodiversity Heritage Site is a unique conservation approach recognised under Section 37 (1) of the Biological Diversity Act, 2002 the State Government may, from time to time, in consultation with the local bodies, notify in the official Gazette of areas of biodiversity importance as Biodiversity Heritage Sites.

Those sites that are unique, ecologically fragile ecosystems - terrestrial, coastal, and inland waters, and marine, having rich biodiversity comprising of any one or more of the following components: richness of wild as well as domesticated species or Intra-specific categories, high endemism, presence of rare and threatened species, keystone species, species of evolutionary significance, wild ancestors of domestic/cultivated species or their varieties, past pre-eminence of biological components represented by fossil beds and having significant cultural, ethical or aesthetic values and are important for the maintenance of cultural diversity, with or without a long history of human association with them. So far, 44 Biodiversity Heritage Sites have been notified by 16 states.

1. Under Section 37 of Biological Diversity Act, 2002 (BDA) the State Government in consultation with local bodies may notify in the official gazette, areas of biodiversity importance as Biodiversity Heritage Sites (BHS).
2. Under sub section (2) of Section 37, the State Government in consultation with the Central Government may frame rules for the management and conservation of BHS.
3. Under sub section (3) of Section 37, the State Governments shall frame schemes for compensating or rehabilitating any person or section of people economically affected by such notification.

Considering the above provisions of the Act, the National Biodiversity Authority (NBA) issues guidelines for selection and management of the BHS.

Heritage Trees

Heritage trees are special trees that are considered to be of cultural, ecological value, and biological significance. These trees are often the oldest living things in a community and providing habitat for wildlife. Based on ecological, socio-cultural significance alternative livelihood opportunities, and conservation efforts (conservation ethics) on regions, some case studies were conducted:

"Nature is not a place to visit, it is home."

– Gary Snyder

1. **Western Himalaya–** A study explored the role of Sacred Groves in biodiversity conservation, highlighting the presence of diverse flora and fauna.
2. **Devithans in Sikkim–** explores the role of Devithans (Sacred Groves) in the Lepcha-Bhutia community.
3. **Sacred and protected Groves of Andhra Pradesh.**
4. **Purvatali Rai–** Sacred Grove in Goa, declared as Biodiversity Heritage Site in 2019.
5. **Mawphlang–** Sacred Groves preserved by local Khasi communities in Meghalaya.

Challenges

Sacred Groves have been legally protected under the Community Reserves in the Wildlife (Protection) Amendment act, 2002, these are the best examples for community conservation and also unique source for *in-situ* conservation but, in the modern era, the groves are facing serious threat due to:

1. **Habitat loss:** Due to developmental activities like urbanisation, infrastructure development, and expansion of agriculture in top hills many sacred groves are being cleared or fragmented, which can harm the plants and animals that live there.
2. **Climatic change:** Threatens the forest health and ecosystem, due to sudden and abrupt changes in temperatures. This is leading to rapid erosion of the sacred groves, their ecology, floral compositions, including medicinal taxa.
3. **Global warming:** Increase of temperature for a long time, disrupts weather patterns, like heat waves, droughts, floods, forest fires causes changes in forest ecosystem, this will lead to loss of biodiversity.
1. **Invasive/ Alien species:** These are introduced species that can harm the native species. Often, they are considered one of the major threats to the entire ecosystem, e.g. *Chromolaena odorata, Lantana camara and Prosopis juliflora*.
2. **Exploitation of resources:** In some cases, local communities may collect too much firewood, medicinal plants, or other resources from the sacred grove. This can put a strain on the ecosystem and lead to degradation.
3. **Other challenges:** Anthropogenic pressure, encroachment, deforestation, cultural degradation, pollution, and no proper legislations, etc.

Management of Sacred Groves

Some groves are under the custody and management of local communities or tribes. Some are owned and managed by the village communities through a system of hereditary trusteeship. All management decisions are made collectively by the entire village during the annual rituals in the sacred grove. Community Involvement, Sustainable Practices, Scientific Collaboration with Organisations, Balancing customs, Religious Beliefs and Conservation are key principles for management of Sacred Groves.

Legislations

The Wildlife (Protection) Act, 1972 empowers the State Government for declaration of any private or community land, as a community reserve, for protecting flora fauna, traditional or cultural conservation values and practices.

Wildlife (Protection) Amendment Act, 2002: This act introduced the concept of 'Community Reserves', which can be used to provide government protection to sacred groves on community-conserved lands. This act prohibits hunting and logging within these areas.

Biological Diversity Act 2002 (the Biological diversity (Amendment) act, 2023)

Several steps are being taken for the conservation of biodiversity, which includes survey, inventorisation, taxonomic validation, and threat assessment of floral and faunal resources; assessment to develop an accurate database for planning and monitoring as well as conservation and protection of forests; establishment of a protected area network of National Parks, Wildlife Sanctuaries, conservation and community reserves; designating Biosphere Reserves for conservation of representative ecosystems; undertaking of species oriented programmes, such as Project Tiger, Project Elephant, Project Dolphin; complemented with ex-situ conservation efforts in the 10 biogeographic zones of the country. For ensuring protection of flora and fauna within protected areas, management plans are prepared by State Forest Departments which inter alia include a schedule of activities to be taken up over a period of ten years. This amendment act shall come into force on 1 April 2024.

Constitutional Protection

There is no specific article directly mentioning sacred groves but there are a few articles that can be interpreted to some level of protection of sacred groves.

Article 25(1): This article guarantees the freedom of conscience and the right to practice and propagate religion. This right extends to the protection of practices associated with sacred groves, as long as they do not violate the rights of others.

Article 48A: Directs the state to protect and improve the environment and to safeguard the forests and wildlife of the country. This can be seen as providing an indirect mandate for the protection of sacred groves, as they represent both environmental and cultural importance.

Article 51A(g): This article imposes a fundamental duty on every citizen to protect and improve the environment and to have compassion for living creatures reflecting the respect for nature inherent in sacred groves.

National Institutions

The Ministry of Environment, Forest and Climate Change (MOEFCC): Recognises the importance and conservation of sacred groves in India. The ministry has provided funding for research on sacred groves, and it has also worked with local communities to develop management plans for these areas. e.g. The CPR Environmental Education Centre CPREEC), a centre of excellence of the MOEFCC, has recorded thousands of sacred groves across India Himachal Pradesh tops the list with 5,000 sacred groves.

The National Biodiversity Authority (NBA): The National Biodiversity Authority (NBA) was established in 2003 to implement India's Biological Diversity Act (2002), Headquarters in Chennai, Tamil Nadu. It is a statutory body and that performs

facilitative, regulatory and advisory function on issue of conservation, sustainable use of biological resource, and the fair and equitable sharing of benefits of arising from their utilisation to the convention on Biological Diversity.

State Biodiversity Boards: Recognises that sacred groves are important for biodiversity conservation, and it has developed a number of capacity building/awareness programmes to support the protection and management of groves.

Biodiversity Management Committees (BMCs)

Every local body at the Gram Panchayat level in the rural areas and at the Nagar Panchayat or Municipal Committee at the Municipal Corporation level in the urban areas shall constitute a Biodiversity Management Committee. The committees are responsible for promoting conservation, sustainable use, and documentation of biological diversity, including the preservation of habitats, conservation of land races, folk varieties and cultivators, domesticated breeds of animals, and microorganisms, as well as the chronicling of knowledge relating to biological diversity.

Other National Institutions

National Green Tribunal, State Forest Departments, Tourism Department, local communities, and NGOs (CPR Foundation), etc.

International Organisations

1. **The United Nations Environment Programme (UNEP)** focuses on traditional knowledge and biodiversity conservation.
2. **The United Nations Educational, Scientific and Cultural Organisation (UNESCO)** has a programme on 'World Heritage Indigenous Peoples' that recognises the importance of sacred groves for cultural heritage and biodiversity conservation. For example Osun-Osogbo Sacred Grove of Nigeria is UNESCO World Heritage Site.
3. **The World Wildlife Fund for Nature** has funded projects that support the conservation of sacred groves around the world.
4. **The World Conservation Union** is an international organisation that brings together governments and NGOs to work on conservation issues and has developed a number of guidelines for the management of sacred sites, including sacred groves.
5. **Conventional on Biological Diversity (CBD)** acknowledges the significance of sacred natural sites and encourages collaboration between governments, indigenous and local communities, and other stakeholders, helping to raise awareness about the importance of biodiversity conservation.

Conclusion

Sacred groves have been legally protected under community reserves under the Wildlife (Protection) Amendment Act, 2002. These are the best examples of community conservation and unique source for *in-situ* conservation, but in the modern era, the groves are facing serious threats due to rapid urbanisation, cultural shifting, anthropogenic pressure, global warming, and climatic change, etc., leads to rapid erosion of the sacred groves, their ecology, floral & faunal compositions, and socio-cultural significance. Hence, there is an urgent need to promote/ initiate conservation measures both of *in-situ,* and *ex-situ;* stringent government legislation (legal protection) and awareness programmes that includes traditional knowledge, cultivars, folk varieties, and incentives for research & development are necessary to protect these groves for future generations.

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References

1. Anonymous 1999.Andhra Pradesh Ioni Pavitra, Rakshita Vana sampada (in Telugu) WWF Pp. 1-114.
2. Anonymous 1999. Sacred and Protected Groves of Andhra Pradesh) WWF. pp. 1-96.
3. B. Ravi Prasad Rao, M.V. Suresh Babu, M. Sridhar Reddy, A. Madhusudhana Reddy, V. Srinivasa Rao, S. Sunita & K.N. Ganeshaiah. 2011. Sacred groves in Southern Eastern ghats, India: Are they better managed than forest reserves? *Tropical Ecology* 52(1): 79-90.
4. The Eastern Ghats EPTRI- ENVIS Newsletter 2008. Vol.14, No.04
5. Focus on Sacred Groves & Ethnobotany 2004. Published by *prism publications*, Mumbai
6. Gadgil, M. & Vartak V.D. 1975. Sacred Groves of India a plea for continued conservation *J. Bombay Nat.His.soc*., Vol. 72(2): 314-321.
7. https://pib.gov.in/indexd.aspx .
8. https://www.google.com
9. https://egazette.gov.in/WriteReadData/2023/247815.pdf
10. Khumbongmayum, M.D., Khan, M.L., and Tirupathi, R.S, Sacred groves of Manipur- ideal centers for biodiversity and conservation (http://ias.ac.in/ currsci/ aug 252004/430/pdf) current science, Vol 87, No 4, 25 Aug 2004.
11. Murugesan, Amirthalingam(2016). Sacred Groves of India- An Overview. *International Journal of Current Research in Biosciences and Plant Biology*.3.64-74.
12. M. Amirthalingam., 1998. Sacred Trees of Tamilnadu published by C.P.R. *Environmental Education Centre*, Chennai.
13. M. Amirthalingam., 1998. Sacred Groves of Tamilnadu - A survey published by C.P.R. *Environmental Education Centre*, Chennai.
14. Sankara Rao, M., Ashok Kumar Panigrahi & Alakasahu (2017). A note on the Gadi Central Pandam Sacred Grove of East Sikkim, Sikkim, India. *Annals of Plant Sciences* (8): 1656-1657.
15. M. Sankararao (2016). Role of Sacred groves in conservation of medicinal plants in Northern part of Andhra Pradesh, India. H.K.Chourasia (ed.) *Conservation of medicinal plants: conventional and modern approaches,* Omega publications, New Delhi.pp. 167-173. (ISBN: 978-81-8455-588-2)
16. M. Sankara Rao, P. Hari Krishna, N.S.S.N. Kedareswari, V. Gnanojwala, B. Suresh Kumar, T. Aravinda and K. Kalyani Bai (2023) 'Phytodiversity and its significance of the Pamuleru Sacred grove in Alluri Sitharamaraju District of Andhra Pradesh, India' Nelumbo 65(1): Pp 239-244.

BLUE ECONOMY

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According to the World Bank, the blue economy is defined as the sustainable development of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem. The blue economy emphasises the integration of the development of the ocean economy with social inclusion and environmental sustainability, combined with innovative business models. Oceans are considered future growth engines, even with the changing climate and other anthropogenic pressures. The blue economy is thus positioned as a core dimension for national growth, reflecting India's commitment to sustainable development and responsible use of ocean resources. Striking the right balance between economic development and environmental preservation is crucial.

The oceans and seas cover over 70% of the planet, supporting our life source and that of every other organism on earth. The ocean works as a huge reservoir of heat and plays an important role in moderating the weather and climate. The ocean is responsible for almost half of the oxygen that is inhaled and also plays a pivotal role in the carbon cycle. It is home to most of the earth's biodiversity and is the main source of protein for more than a billion people around the world. With at least 3-5% of global GDP derived from oceans, the blue economy, through sustainable use of oceans, has great potential for boosting economic growth by providing opportunities for income generation, jobs, etc. The United Nations has promulgated the period 2021-2030 as the 'UN Decade of Ocean Science for Sustainable Development'. The

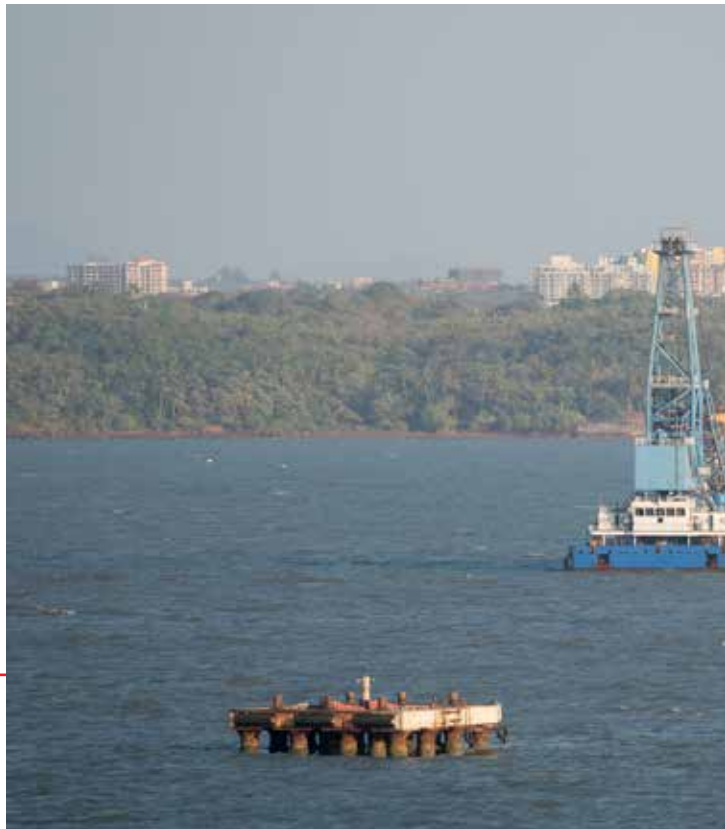
emerging blue economy seeks to drive economic growth and social inclusion while at the same time preserving marine and coastal areas from exploitation and environmental degradation. The decade seeks to encourage integrated and interdisciplinary approaches to sustainable ocean management through the collaboration of scientists, policymakers, local communities, industry, and civil society.

India has a coastline of more than 7500 km and an Exclusive Economic Zone (EEZ) of more than 2.2 million sq km. Nine of India's states have access to the coastline. India comprises 200 ports, of which 12 are major ports that handled 541.76 million tonnes in FY21, the highest being Mormugao Port, located in Goa, which handled 62.6% of the total traffic. The coastal economy sustains over 4 million fishermen and coastal towns. India is the second-largest fish-producing nation in the world and has a fleet of 2,50,000 fishing boats. The blue economy of India is a subdivision of the national economy that includes the complete ocean resources system as well as human-made economic infrastructure in the country's legal jurisdiction in marine, maritime, and onshore coastal zones. India's Blue Economy concept is multi-faceted and plays an important role in the country's economic growth because of its enormous maritime interests. India's blue economy accounts for roughly 4% of the GDP and is estimated to increase once the mechanism is improved.

Various agricultural revolutions have occurred in India and have marked the beginning of a completely new era in the agricultural field. Next, India's service revolution has shown that industrialisation is not the only route to rapid economic development. A majority of FDI inflows into India are concentrated in the service sector. Thanks to the 3Ts — tradability, technological innovation, and transport—services can be unbundled, splintered in a value chain just like goods, and electronically transported globally. Recently, after the success of the Chandrayaan-3 Mission, the Indian space technology sector has shown significant growth and development over the past few decades, with the Indian Space Research Organisation (ISRO) at the forefront of the country's space program. Now the next step is to focus on the ocean economy. Over the past decade, India has built expertise and facilities in the field of ocean scene and technology and is part of many international bodies in developing global policies, and this contribution is well appreciated globally.

The concept of the blue economy was introduced by Gunter Pauli in his 2010 book – 'The Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs'. According to the World Bank, the blue economy is defined as the sustainable development of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem. The Blue Economy emphasises the integration of the development of the ocean economy with social inclusion and environmental sustainability, combined with innovative business models. Oceans are considered future growth engines, even with the changing climate and other anthropogenic pressures. Sectors like fisheries and aquaculture, coastal and beach tourism, offshore wind installations, shipping and ports, coastal agriculture, etc., will drive this growth. These sectors are important globally, particularly to developing countries, in the context of sustainable development, poverty eradication, and energy, food, and nutrition security. According to research commissioned by the high-level panel for a sustainable ocean economy, USD 1 invested in key ocean activities yields five times, i.e., USD 5 in return, often more.

The blue economy encompasses a diverse range of activities that are critical for sustainable development. Some are listed below:



1. **Renewable Energy:** Sustainable marine energy, such as offshore wind and wave energy, plays a vital role in promoting social and economic development while reducing reliance on non-renewable energy sources.
2. **Fisheries:** Sustainable fisheries management is essential for generating more revenue, ensuring a continuous supply of fish, and contributing to the restoration of fish stocks, thus supporting both economic and environmental goals.
3. **Maritime Transport:** With over 80% of international goods being transported by sea, maritime transport is a cornerstone of the global economy, connecting nations and facilitating trade.
4. **Tourism:** Ocean and coastal tourism not only offer recreational opportunities but also contribute to job creation and economic growth, making it a key component of the blue economy.
5. **Climate Change:** Oceans act as crucial carbon sinks, absorbing and storing carbon dioxide, a phenomenon known as 'blue carbon.' This role helps mitigate climate change by reducing greenhouse gas concentrations in the atmosphere.
6. **Waste Management:** Effective waste management on land is integral to the health of oceans. Proper waste disposal practices prevent pollution, marine debris, and environmental degradation, fostering ocean recovery.

The interconnected nature of these activities highlights the holistic approach needed for the sustainable development of the blue economy. By addressing renewable energy, fisheries, maritime transport, tourism, climate change mitigation, and waste management collectively, nations can harness the economic potential of the oceans while safeguarding their health and resilience.

Underlying the importance and relevance of the blue economy for India, the following discussion is divided into five parts, namely

1. Ocean resources (Living and Non-living)
2. Ports, Shipping, and Marine Tourism
3. Ocean Science and Services
4. Niche areas: Coastal and Marine Spatial Planning and Ocean Accounting
5. Sources of Employment in the Blue Economy

Ocean Resources

The ocean and its EEZ offer great economic opportunities, having both living and non-living resources.

Fisheries and aquaculture: Fisheries can be sub-categorised into two categories: marine fisheries and inland fisheries. Fisheries have contributed Rs. 46,663 crore to the economy through exports in 2019-20. In the past decade, aquaculture production has evidenced tremendous growth. In 1950-51, fish production amounted to 0.75 MMT (million metric tonnes), and in 2019-20, it was 14.2 MMT. Out of 14.2 MMT production, marine fish production was 3.7 MMT, and inland fish production was 10.4 MMT (Annual Report of the Ministry of Fisheries, Animal Husbandry and Dairying, 2021). There is a fear of depletion of the natural reserve of major fish species due to growing demand for consumption and increased capture due to technological advancements.

Minerals: The continental margins of India congregate an extensive variety of terrigenous, biogenous, and homogenous mineral deposits, and heavy minerals like ilmenite, magnetite, monazite, zircon, and rutile were reported from the beaches of Indian coastal states. Biogenous sediments are reported from shallow offshore areas of the Laccadive Islands, the Gulf of Kutch, the outer shelf of Mumbai, and the backwaters of Kerala. Homogenous deposits like phosphorites

are reported from the southwestern and western continental shelves manganese crust is found in the Andaman Islands. Evidence has been found of reserves of Manganese, cobalt, and hydrothermal sulphides in the deep ocean in the Central Indian Ocean Basin (CIOB). Also, marine gypsum is found in salt pans during the processing of common salt in the coastal regions of Gujarat and Tamil Nadu. Ocean also contains huge rare earth minerals. These minerals are crucial raw materials for manufacturing electronic chips for industries like electronics, automotive, etc.

Hydrocarbons: The sea beds are the major source of hydrocarbons. India has 26 sedimentary basins, spread across a total area of 3.4 million square kilometres. Of the total sedimentary area, 49% is located inland, 12% is in shallow water with depths up to 400 metres, and 39% is in the deepwater area extending farther up to the Exclusive Economic Zone. There are 16 inland basins, seven located both inland and offshore, and 3 completely offshore. India hosts about 34 MMT of oil and 33 BCM of gas production (Directorate General of Hydrocarbons Annual Report 2021). The current annual oil and natural gas consumption is about 1.3 billion barrels and 65 billion cubic metres, which is not met with internal resources, raising dependence on imports.

Renewable Energy: Renewable energy includes energy from natural phenomena like sunlight, Onshore wind, Offshore wind, hydroelectric, tides, waves, etc. The generation of oceanic renewable energy has tremendous scope. Commercialisation of tidal energy has gained momentum in the past few years. Technologies like tidal lagoons, tidal reefs, tidal fences, and tidal barrages are used for tidal energy generation. Renewable energy in offshore regions has tremendous potential in the form of offshore wind, waves, ocean currents, including tidal currents, and thermal energy. Out of all the different renewable energies generated from oceans, the offshore wind energy industry is the most developed.

Ports, Shipping, and Marine Tourism

Services India has a network of 12 major ports and 187 non-major ports. The Indian maritime industry plays a crucial role in the logistics sector. Approximately 95% of the country's trade by volume and 68% by value is moved through maritime transport (EAC report: India's Blue Economy, 2020). The Indian Maritime Sector comprises ports, shipping, marine biotechnology, shipbuilding and repair, and inland water transport systems. Other riparian industries, namely fishing, aquaculture, tourism, net manufacturing, and aquaculture technology, contribute to the country's economy. Other marine services include marine insurance. The shipping sector is also one of the key livelihood providers in the blue economy, as India has one of the largest merchant shipping fleets among the developing countries and ranks 17th in the world. Marine tourism is the fastest growing globally, and in India, coastal tourism has contributed largely to both the state economies and livelihood creation. Tourism has certain potential as a source of income for the local community, but tourism on a large scale can have an adverse impact on the marine ecosystem.

Ocean Science and Services

Observations, data, and information services: Ocean and coastal observations, data, and information services are of paramount importance for all Blue Economy stakeholders. Operational services such as Marine Fishery Advisories, Ocean State Forecasts, Tsunami and Storm Surge Early Warnings, Sea Level Rise, Oil Spill Trajectories, Marine Search and Rescue Information, Water Quality Forecasts, Coral Bleaching Alerts, Harmful Algal Blooms, Coastal Vulnerability, etc. are key to enhancing the safety of lives and livelihoods of coastal communities, the efficiency of maritime operations and sustainable management of ocean and coastal ecosystems. The Indian National Centre for Ocean Information Services (NCOIS) provides flagship service advisories on the Potential Fishing Zones (PFZ) each day of the year except during the fishing ban period and adverse sea-state conditions.

Impact of climate change and disasters on the blue economy: Promoting a sustainable and climate-resilient blue economy has a special responsibility towards the ocean, as all of them are coastal states, collectively responsible for 45 per cent of the world's coastlines and over 21 per cent of Exclusive Economic Zones (EEZs). The ocean holds vast natural capital (Ocean Asset Value), estimated at USD 24 trillion. However, ocean warming, sea-level rise, ocean acidification, and marine pollution are damaging marine ecosystems, productivity, and the lives and livelihoods of those dependent

on the ocean. Nearly 40 per cent of the SDGs depend on ocean sustainability, particularly SDG 14 (life below water) and SDG 13 (climate action). Yet, progress on SDG 14 is slow and inadequate, and in 2019, it received the least funding from official development assistance providers. While coastal areas remain in the spotlight of climate-induced vulnerability, oceans play a crucial role in mitigating global climate change by sequestering about 25% of global anthropogenic emissions of carbon dioxide. Evidence suggests that the net sink has remained the same in recent decades, despite increasing atmospheric CO_2, indicating its weakening potential in climate change mitigation. Coastal ecosystems such as mangroves, seagrass beds, and saltmarshes that contribute to coastal protection and marine biodiversity are adversely affected by climate change.

Coastal hazards such as tsunamis, floods, sea level rise, and earthquakes undermine the resilience and sustainability of the blue economy (IPCC, 2019; Karanja and Saito, 2018). Climate change is expected to increase the frequency and intensity of hydrological, meteorological, and climatological disasters such as floods, tropical cyclones, and droughts (IPCC, 2019). In view of the recent natural coastal disasters faced in southern India, an effective response mechanism to address humanitarian crises and natural disasters should be made.

Behind every warning lies the pivotal role of observation and forecasting. The Early Warnings for All initiative by the World Meteorological Organization and other UN bodies is an effort to ensure everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027. With human-induced climate change leading to more extreme weather conditions, the need for early warning systems is more crucial than ever. Early warning systems are not a luxury but a cost-effective tool that saves lives, reduces economic losses, and provides a nearly tenfold return on investment. Also, a 'Community-Based Flood Early-Warning System' needs to be established with the networking of state and central agencies and the support of local bodies and NGOs. Information and communications technology (ICT)-enabled systems to monitor water levels, mapping of water bodies, desilting, and systematic data collection; geomorphological mapping of the floodplain combined with the analysis of flood management can be an efficient tool for flood hazard assessment and prediction of future flood scenarios.

Marine Biodiversity: Conservation and sustainable use of marine and coastal biodiversity, including the declaration of marine protected areas (MPA), is essential to ensuring that the world's oceans, seas, and marine living resources remain vital for current and future generations.

As per SDG 14.2, 20% of EEZs need to be declared MPAs by 2030, and concerted efforts are a must to achieve this. The more effective management of fisheries that are used for food, protection of the marine environment from pollution, including from agriculture, and destructive actions are critical actions to be taken. India's Exclusive Economic Zone (EEZ) has huge living and non-living resources, including significant recoverable resources such as crude oil and natural gas. The coastal economy sustains over 4 million fisherfolk and coastal communities. Better connectivity in the region will significantly cut transport costs and maritime waste of resources making the trade sustainable and cost-effective. The Indian Ocean's resources have the potential to sustain increased production. The development of the Blue Economy can serve as a growth catalyst for realising the vision to become a $10 trillion economy by 2032.

Healthy Ocean: Marine pollution has grown to be a major concern globally today, dominated by land-based pollution and plastic waste. The United Nations has also called for the prevention and significant reduction of marine pollution of all kinds by 2025, particularly from land-based activities, which are the main source of plastics and microplastics. The Sustainable Development Goals (SDG 14), Life Below Water, of the UN call for conservation and sustainable use of oceans and marine resources. The growing menace of marine pollution, especially from plastics and microplastics, has to be addressed by a robust Plastic Elimination and National Marine Litter policy involving multiple stakeholders. Further, India's recent single-use plastics ban will help address the marine plastic litter challenge, as globally, land-based sources account for ~80 per cent of marine plastic waste. India has played a key role in the global negotiations on single-use plastics that led to a historic resolution at the 5th UNEA session in 2022 to forge an international legally binding agreement to end plastic pollution.

Research Gap: The blue economy is a new topic that started gaining momentum in the twenty-first century. There are many studies on the blue economy at the international level in marine biology, marine technology, marine chemistry, geology, shipping, oceanography, etc. Also, many studies have been carried out at the national level.

Niche areas

Coastal and Marine Spatial Planning: Coastal and Marine Spatial Planning (CMSP) is a science-based approach that can be used to analyse and allocate coastal and marine uses over space and time to address specific ocean management challenges and advance goals for economic development and conservation. Simply put, in the same manner that land zoning regulates land uses, coastal and marine spatial planning can create ocean zoning, with maps categorising marine space for specific uses. pan, and China. India will now be the sixth country to have it. Marine Spatial Planning (MSP) has been used to allocate human activities spatially, usually through participatory processes, to reconcile differing values and priorities among diverse stakeholders. Ocean Accounting (OA) can provide a structured and integrated 'data foundation' that shapes policy through providing a range of comparable statistics and indicators. These policies, in addition to legislation and other layers of governance, define the objectives of MSP, where OA may provide data to assist in the formation of plans and further evaluate progress towards policy targets. The two frameworks (OA and MSP) possess several synergies that further effective and evidence-based ocean governance. The Ocean Accounts Framework (OAF) is a conceptual framework designed to enhance the consistency, comparability, and coherence of ocean-related maps, data, statistics, and indicators across social, environmental, and economic domains.

Source of Employment in the Blue Economy

Traditional Sectors

Fishing and Aquaculture: Traditional sectors like fishing, aquaculture, and fish processing have been significant sources of employment in the blue economy for many decades. The sector is evolving from subsistence farming to commercial practices, such as aquaculture, requiring a skilled workforce.

Marine Tourism: Marine tourism, including activities like cruise travel, boating, scuba diving, and more, contributes to employment and economic growth in coastal regions. Coastal tourism is a vibrant segment of the blue economy, supporting jobs in hospitality, transportation, and various tourism-related services.

Shipping and Ports: Sea ports are major sources of employment, with jobs in smaller ports increasing over the years. The growth in the logistics sector, driven by industrial demand, emphasises the increasing role of ports in future employment.

Shipbuilding: The shipbuilding industry in India holds significant potential and employs individuals with diverse skills. Indigenisation and self-reliance in the industry could further contribute to employment generation.

Offshore Wind and Marine Biology : Emerging sectors like offshore wind and marine biology provide new employment opportunities. The move towards sustainability in shipbuilding involves using recyclable or biodegradable materials, ensuring energy and resource efficiency.

Skill Development Initiatives: The blue economy has the potential to engage a large workforce and has been doing so for the past many decades, at least in traditional sectors such as fishing, aquaculture, fish processing, marine tourism, shipping, and port activities. Now, engagement in new sectors such as offshore wind, marine biology, biotechnology, and other activities like shipbuilding and shipbreaking is also gaining extensive traction**.** Sea ports are a large source of employment. Unlike India's major ports, jobs in smaller ports have increased to tenfold over the years from 2003 to 2017. Shipping and ports require skilled manpower, but meeting the growing and changing demands in this sector would require re-skilling and upskilling in the future. The full potential of the blue economy can be realised by creating suitable employment opportunities for present and future generations. Acknowledging and giving prominence to traditional knowledge is crucial. It ensures the preservation of cultural heritage and sustainable practices that have been integral to traditional fishing communities. Blue economy, spanning traditional and emerging sectors, offers diverse employment opportunities. From traditional fishing practices to innovative sectors like offshore wind and marine biology, the blue economy is evolving. Skill development initiatives, youth involvement, and the preservation of traditional knowledge are integral to harnessing the full potential of the blue economy and ensuring prosperity for all. ❑

THE RAMSAR CONVENTION ON WETLANDS

The Convention on Wetlands of International Importance holds the unique distinction of being the first modern treaty between nations aimed at conserving natural resources. The signing of the Convention on Wetlands took place in 1971 at the small Iranian town of Ramsar. Since then, the Convention on Wetlands has been known as the Ramsar Convention. The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. This requires international cooperation, policy making, capacity building and technology transfer.

Under the Ramsar Convention, a wide variety of natural and human-made habitat types ranging from rivers to coral reefs can be classified as wetlands. Wetlands include swamps, marshes, billabongs, lakes, salt marshes, mudflats, mangroves, coral reefs, fens, peat bogs, or bodies of water - whether natural or artificial, permanent or temporary. Water within these areas can be static or flowing; fresh, brackish or saline; and can include inland rivers and coastal or marine water to a depth of six metres at low tide. There are even underground wetlands.The Ramsar Convention encourages the designation of sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity. Once designated, these sites are added to the Convention's List of Wetlands of International Importance and become known as Ramsar sites. In designating a wetland as a Ramsar site, countries agree to establish and oversee a management framework aimed at conserving the

wetland and ensuring its wise use. Wise use under the Convention is broadly defined as maintaining the ecological character of a wetland.

Under the Ramsar Criteria, wetlands should be selected for the Ramsar List on account of their international significance in terms of the biodiversity and uniqueness of their ecology, botany, zoology, limnology or hydrology. In addition, the Criteria indicate that in the first instance, wetlands of international importance to waterbirds at any season should be included on the Ramsar List.

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

Criterion 9: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

Ramsar Wetlands Sites in India (As in January 2024)

Jammu and Kashmir

- **Hokera Wetland**: A natural perennial wetland contiguous to the Jhelum basin, it is the only site with remaining reedbeds of Kashmir and pathway of 68 waterfowl species. It is an important source of food, spawning ground and nursery for fishes, besides offering feeding and breeding ground to a variety of water birds.
- **Hygam Wetland Conservation Reserve:** The wetland is located within the Jhelum river basin and plays a significant role in flood control, aquifer recharge, and regulating water flow of the Wular Lake.
- **Shallbugh Wetland Conservation Reserve:** It lies west of Anchar Lake in the Sindh river delta. This shallow wetland is primarily fed by rainfall, snowmelt from the Kashmir Himalayas, and stream water flowing from the Sindh river and Anchar Lake.
- Other Sites include Surinsar-Mansar Lakes and Wular Lake.

Ladakh

- **Tso Kar Wetland Complex:** This high-altitude wetland complex is found at more than 4,500 metres above sea level in the Changthang region of Ladakh. The complex includes two connected lakes, the freshwater Startsapuk Tso and the larger hypersaline Tso Kar; it presents a notable example of two such lakes existing in close proximity.
- **Tsomoriri Lake:** A freshwater to brackish lake lying at 4,595m above sea level, with wet meadows and borax-laden wetlands along the shores. The site is said to represent the only breeding ground outside of China for one of the most endangered cranes, the Black-necked crane and the only breeding ground for Bar-headed geese in India.

Himachal Pradesh

- **Chandertal Wetland:** A high altitude lake on the upper Chandra valley flowing to the Chandra River of the Western Himalayas near the Kunzam pass joining the Himalayan and Pir Panchal ranges. It supports CITES and IUCN Redlisted Snow Leopard and is a refuge for many.
- **Pong Dam Lake:** A water storage reservoir created in 1975 on the Beas River in the low foothills of the Himalaya on the northern edge of the Indo-Gangetic plain. Hydrological values include monsoon-season flood prevention, both in the surroundings and downstream due to water regulation, groundwater recharge, silt trapping and prevention of soil erosion.
- **Renuka Wetland:** A natural wetland with freshwater springs and inland subterranean karst formations, fed by a small stream flowing from the lower Himalayan out to the Giri River.

Punjab

- **Beas Conservation Reserve:** The Beas Conservation Reserve is a 185-kilometre stretch of the Beas River located primarily in the north-west of the State of Punjab. The River is dotted with islands, sand bars, and braided channels creating a complex environment supporting substantial biodiversity.
- **Keshopur-Miani Community Reserve:** The Reserve is a mosaic of natural marshes, aquaculture ponds and agricultural wetlands maintained by the annual rainfall runoff. It is heavily human-influenced, and includes a series of managed fishponds and cultivated crops such lotus and chestnut.

- **Nangal Wildlife Sanctuary:** Located in the Shiwalik foothills of Punjab is the highly eco-sensitive Nangal Wildlife Sanctuary, which supports abundant flora and fauna including threatened species. It occupies a human-made reservoir constructed as part of the Bhakra-Nangal Project in 1961.
- Other Sites include Ropar Lake, Harike Lake, and Kanjli Lake.

Rajasthan

- **Keoladeo Ghana NP:** A complex of ten artificial, seasonal lagoons, varying in size, situated in a densely populated region. Vegetation is a mosaic of scrub and open grassland that provides habitat for breeding, wintering and staging migratory birds. Cattle and water buffalo graze on the site.

- **Sambhar Lake:** A large saline lake fed by four streams set in a shallow wetland and subject to seasonal fluctuations. It is surrounded by sand flats and dry thorn scrub and fed by seasonal rivers and streams. The site is important for a variety of wintering waterbirds, including large numbers of flamingos.

Haryana

- **Bhindawas Wildlife Sanctuary:** It is a human-made freshwater wetland, and is the largest wetland in Haryana State. The wetland was declared as a protected area in 1986 and was designated as an Eco-sensitive zone by the Ministry of Environment, Forests and Climate Change in 2011.
- **Sultanpur National Park:** This shallow lake at the core of the Sultanpur National Park is fed

by the overflow from neighbouring canals and fields, and replenished by saline groundwater. The lake features seasonal aquatic vegetation and is dotted with artificial islands; the Park also includes open grasslands.

Uttar Pradesh

- **Bakhira Wildlife Sanctuary:** This freshwater marsh in the Sant Kabir Nagar district is the largest natural floodplain wetland of eastern Uttar Pradesh. The Site is also used for recreation and tourism and contributes to food supply and nutrient cycling.
- **Haiderpur Wetland:** This human-made wetland was formed in 1984 by the construction of the Madhya Ganga Barrage on a floodplain of the River Ganga. It is located within the boundaries of Hastinapur Wildlife Sanctuary.

- **Nawabganj Bird Sanctuary:** A shallow marshland 45 kilometres from Lucknow in Uttar Pradesh. Monsoon rains feed this diverse wetland while the Sarda Canal supplies additional water. The Sanctuary supports recreation and tourism activities as well as local biodiversity.
- Other Sites include Parvati Agra Bird Sanctuary, Saman Bird Samaspur Bird Sanctuary, Sandi Bird Sanctuary, Sarsai Nawar Jheel, Sur Sarovar, and Upper Ganga River.

Uttarakhand

- **Asan Conservation Reserve:** It is a 444-hectare stretch of the Asan River running down to its confluence with the Yamuna River in Dehradun district of Uttarakhand.

Madhya Pradesh

- **Bhoj Wetlands:** The lakes are very rich in biodiversity, particularly for macrophytes, phytoplankton, zooplankton, both natural and cultured fish species, both resident and migratory birds, insects, and reptiles and amphibians.
- **Sakhya Sagar:** It is a human-made reservoir on the outskirts of Shivpuri town within the Madhav National Park. The Site features a

mosaic of landforms including open water and surrounding marshes, plantations and a small patch of agricultural land.

- Other Sites include Sirpur Wetland and Yashwant Sagar.

Bihar

- **Kabartal Wetland:** Kabartal Wetland, also known as Kanwar Jheel, covers 2,620 hectares of the Indo-Gangetic plains in the northern Bihar State. The Site is one of 18 wetlands within an extensive floodplain complex; it floods during the monsoon season to a depth of 1.5 metres. This absorption of floodwaters is a vital service in Bihar State where 70% of the land is vulnerable to inundation.

Gujarat

- **Khijadia Wildlife Sanctuary**: As one of the important waterbird habitats in North-West India, the Site provides breeding, feeding and roosting grounds for a wide range of resident aquatic and also land-based birds.
- **Nalsarovar Bird Sanctuary:** A natural freshwater lake (a relict sea) that is the largest natural wetland in the Thar Desert Biogeographic Province and represents a dynamic environment with salinity and depth varying depending on rainfall.
- Other Sites include Thol Lake Wildlife Sanctuary and Wadhvana Wetland.

Maharashtra

- **Lonar Lake:** This wetland on the Deccan Plateau is an endorheic or closed basin, almost circular in shape, formed by a meteorite impact onto the basalt bedrock. The Site includes the lake as well as escarpments, which form the crater walls, and forested zones.
- **Nandur Madhameshwar:** The Site is a mosaic of lakes, marshes and riparian forest on the Deccan Plateau. Construction of the Nandur Madhameshwar Weir at the confluence of the Godavari and Kadwa Rivers helped create a thriving wetland.
- **Thane Creek:** The Site is one of the largest creeks of Asia and hosts many birds migrating on the Central Asian Flyway. As a sanctuary for flamingos and other important bird species, it is in the list of Important Bird and Biodiversity Areas (IBAs).

Odisha

- **Ansupa Lake:** A small freshwater oxbow lake formed by the Mahanadi river, is known nationally for its scenic beauty and rich biodiversity. Some 194 species of birds, 61 fish species, 244 macrophytes, 88 butterflies and 26 mammals are supported by the wetland.
- **Bhitarkanika Mangroves:** One of the finest remaining patches of mangrove forests along the Indian coast - 25 years of continued conservation measures have made the site one of the best known wildlife sanctuaries.
- **Chilka Lake:** Brackish lake separated from the Bay of Bengal by a long sandy ridge and subject to sea water exchange, resulting in extreme seasonal fluctuations in salinity in different sections of the lake. Saline areas support aquatic algae.

- Other Sites include Hirakud Reservoir, Satkosia Gorge, and Tampara Lake.

West Bengal

- **East Kolkata Wetlands:** World-renowned as a model of a multiple use wetland, the site's resource recovery systems, developed by local people through the ages, have saved the city of Calcutta from the costs of constructing and maintaining waste water treatment plants.
- **Sunderbans Wetland:** It is located within the largest mangrove forest in the world, the Sundarbans that encompasses hundreds

of islands and a maze of rivers, rivulets and creeks, in the delta of the Rivers Ganges and Brahmaputra on the Bay of Bengal in India and Bangladesh.

Karnataka

- **Aghanashini Estuary:** The Site is an estuary where the Aghanashini River flows into the Arabian Sea in Karnataka State. In addition to its estuarine and shallow marine waters, it features rocky and pebble shores, intertidal mudflats and some aquaculture ponds and rice fields.
- **Ankasamudra Bird Conservation Reserve:** The Site is a human-made wetland built for storing monsoon run-off water coming from the Tungabhadra River and providing irrigation to surrounding drought-risk areas.The Site is widely known for its rich bird diversity and has been declared as a conservation reserve, managed mainly for bird protection.
- Other Sites include Magadi Kere Conservation Reserve and Ranganathittu Bird Sanctuary.

Tamil Nadu

- **Chitrangudi Bird Sanctuary:** The wetland has been a protected area since 1989 and is also classed as an Important Bird and Biodiversity Area (IBA). There are 50 bird species found, including four near-threatened species. The Sanctuary is an important breeding ground for wintering birds.
- **Gulf of Mannar Marine Biosphere Reserve:** Located at the south-eastern tip of India, it is the first Marine Biosphere Reserve in South and South-East Asia. The Gulf is where the southward extension of the Bay of Bengal meets the Indian Ocean, and is one of the most biologically diverse regions in India.
- **Kanjirankulam Bird Sanctuary:** It is a nationally protected area and a notable nesting site for several migratory heron species. It is dominated by sub-tropical forests of babul (*Acacia nilotica*) that provide habitat for endemic and migratory birds.
- Other Sites include Karaivetti Bird sanctuary, Karikili Bird Sanctuary, Koonthankulam Bird Sanctuary, Longwood Shola Reserve Forest, Pallikaranai Marsh Reserve Forest, Pichavaram Mangrove, Point Calimere Wildlife and Bird Sanctuary, Suchindram Theroor Wetland Complex, Udhayamarthandapuram Bird Sanctuary, Vaduvur Bird Sanctuary, Vedanthangal Bird Sanctuary, Vellode Bird Sanctuary, and Vembannur Wetland Complex.

Goa

- **Nanda Lake:** It comprises intermittent freshwater marshes that lie adjacent to one of the major tributaries of the Zuari River. They are

linked to the adjacent river channel by a sluice gate, which when closed enables the flooding of the marshes.

Kerala

- **Asthamudi Wetland:** An extensive estuarine system, the second largest in Kerala State, which is of extraordinary importance for its hydrological functions, its biodiversity, and its support for fish. The site supports a number of mangrove species as well as over 40 associated plant species, and 57 species of birds have been observed, including six that are migratory.
- **Sasthamkotta Lake:** The largest freshwater lake in Kerala state in the southwest of the country, spring-fed and the source of drinking water for half a million people in the Kollam district.
- **Vembanad-Kol Wetland:** The largest brackish, humid tropical wetland ecosystem on the southwest coast of India, fed by 10 rivers and typical of large estuarine systems on the western coast, renowned for its clams and supporting the third largest waterfowl population in India during the winter months.

Andhra Pradesh

- **Kolleru Lake:** A natural eutrophic lake, situated between the two major river basins of the Godavari and the Krishna, fed by two seasonal rivers and a number of drains and channels, which functions as a natural flood balancing reservoir between the deltas of the two rivers.

Assam

- **Deepor Beel:** A permanent freshwater lake in a former channel of the Brahmaputra river, of great biological importance and also essential as the only major storm water storage basin for the city of Guwahati. The beel is a staging site

on migratory flyways and some of the largest concentrations of aquatic birds in Assam can be seen, especially in winter.

Manipur

- **Loktak Lake:** A large, but shrinking freshwater lake and associated swamplands supplied by several streams. Thick, floating mats of weeds covered with soil are a characteristic feature. The lake is used extensively by local people as a source of water for irrigation and domestic use and is an important wintering and staging area for waterbirds, particularly ducks.

Mizoram

- **Pala Wetland:** is the largest natural wetland in the state of Mizoram. The Site includes a relatively deep lake (over 16 metres deep on average) and its surrounding forest catchment area which climbs to almost 600m above sea level. The wetland supports a rich diversity of animal species, including at least seven mammals, 222 birds, 11 amphibians and 21 reptiles.

Tripura

- **Rudrasagar Lake:** A lowland sedimentation reservoir in the northeast hills, fed by three perennial streams discharging to the River Gomti. The lake is abundant in commercially important freshwater fishes. Owing to high rainfall (2500mm) and downstream topography, the wetland is regularly flooded with 4-5 times annual peak, assisting in groundwater recharge. ❑

Source: *MoEFCC & RSIS*

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SUNDARBAN BIOSPHERE

Sundarban, the largest delta in the world, consists of 10,200 sq km of mangrove forest, spread over India (4200 sq km of reserved forest) and Bangladesh (approximately 6000 sq km of reserved forest), and is also the largest mangrove forest in the world. Another 5400 sq km of non-forest, inhabited region in India, along the north and north-western fringe of mangrove forests is also known as the Sundarban region in India. Hence, the total area of the Sundarban region in India is 9600 sq km, which constitutes the Sundarban Biosphere Reserve. The Indian Sundarban is bound on the west by the river Muriganga and on the east by the rivers Harinbhanga and Raimangal. Other major rivers flowing through this ecosystem are Saptomukhi, Thakuran, Matla, and Goasaba.

The entire 9630 sq km of Sundarban was declared as the Sundarban Biosphere Reserve in 1989 through a notification to establish a formal mechanism for coordinating and integrating diverse activities of conservation, research, and training for creating a better situation of harmony between man and environment. The Sundarbans, due to their unique ecosystem, were also declared a World Heritage Site in 1989. Sundarban Biosphere Reserve has also been included as the second Biosphere Reserve from India, other than Nilgiri Biosphere Reserve, in the global network of Biosphere Reserves since November 2001.

Sundarban National Park, forming the core area of Sundarban Tiger Reserve, received recognition as a World Heritage Site by UNESCO in 1987. It has been nominated by the Government of India for recognition as Ramsar Site (a wetland of international importance). Sundarban Tiger Reserve was constituted by the Government of India under the Project Tiger scheme, in 1973. Sundarban is the only mangrove forest in the world that is the home of tigers. Sundarban Tiger Reserve has the highest tiger population in the world.

Sundarban has an extremely rich diversity of aquatic and terrestrial flora and fauna. Its highly productive ecosystem acts as a natural fish nursery. Sundarban mangrove reduces the fury of cyclonic storms and prevents erosion due to tidal action. Millions of people depend on the Sundarban Ecosystem for their livelihood and sustenance through fishing, the collection of honey, and fuelwood/timber.

Geologically, the Sundarban delta is the largest prograding delta on the globe. The region is covered solely by quaternary sediments carried and deposited by the rivers Ganges, Matla, and Bidyadhari.

Although the region is situated south of the Tropic of Cancer, the temperature is equable due to its proximity to the sea. The average annual maximum temperature is around 35°C. The average annual rainfall is 1920 mm and average humidity

is about 82%, which is more or less uniform throughout the year.

Sundarban Mangrove Forest is the single largest home of the Royal Bengal Tiger (Panthera tigris). Sundarban is also the only mangrove forest in the world, with the tiger as its indigenous population. As per the 2004 census, the tiger population in the Indian Sundarban is around 274, out of which the Sundarban Tiger Reserve and South 24-Parganas Forest Division have 249 and 25 tigers respectively. There are 58 species of mammals, 55 species of reptiles, and around 248 bird species.

Sundarbans also harbours a good number of rare and globally threatened animals, including the estuarine crocodile (crocodilus porosus), fishing cat (felis viverrina), common otter (lutra lutra), water monitor lizard (varanus salvator), gangetic dolphin (platinista gangetica), snubfin dolphin (orcella brevirostris), river terrapin (batagur baska), marine turtles like olive ridley (lepidochelys olivacea), green sea turtle (chelonia mydas), hawksbill turtle (eritmochelys imbricata). Six species of shark and ray, which are found here, are included in Schedule I of the Wildlife (Protection) Act. These indicate that Sundarban Reserved Forest is a natural biodiversity hot spot.

Other mammals comprise of wild boars, spotted deer, porcupines and rhesus macaque. Among the reptiles, the king cobra, the common cobra, banded krait, russells viper comprise the community of venomous reptiles, while the python, checkered kill-back, dhaman, green whip snake and several other species constitute the non-venomous snakes. ❑

Source: *www.sundarbanaffairswb.in*

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