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UPSC CSE - 2025

CURRENT AFFAIRS

ENVIRONMENT AND GEOGRAPHY

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CURRENT AFFAIRS

The Himalayan Mountain System and Its Ecological Importance

GS Paper III – Environment & Ecology / Disaster Management

Why in the News?

India's Environment Minister participated in the **Sagarmatha Sambaad 2025** in Kathmandu, Nepal — a high-level global dialogue addressing the theme: **"Climate Change, Mountains, and the Future of Humanity"**, where India called for coordinated global action to protect fragile mountain ecosystems, including the Himalayas.

About the Himalayan Mountain System:

- **Geological Origin:** Result of the collision of the Indian and Eurasian tectonic plates ~50 million years ago.
- **Global Span:** Spread across **India, Nepal, Bhutan, China, and Pakistan**.
- **Indian Himalayan Region (IHR):** Spreads across **13 states/UTs** over ~2,500 km.
- **Glaciers of Significance:** Gangotri, Yamunotri, Zemu, Bara Shigri, etc.
- **River Basins:** Source of 10 major rivers, e.g., Ganga, Brahmaputra, Indus.

Ecological Significance of the Himalayas:

1. Biodiversity Hotspot

- Home to two biodiversity hotspots: **Himalaya and Indo-Burma**.
- ~32% plant endemism; endangered fauna like **snow leopard, red panda**, etc.
- Rich alpine flora (Himalayan blue poppy, rhododendrons) and rare fungi (Gucchi mushroom).

2. Third Pole of the Earth

- Holds **largest reserve of ice outside Arctic & Antarctica**.
- Acts as **Asia's Water Tower**, sustaining over 1.3 billion people downstream.
- ~18,000 glaciers and >2,000 glacial lakes.

3. Climate Regulation

- Influences **Indian monsoon** due to differential heating.
- Himalayan forests sequester ~5.4 billion tonnes of carbon.
- Acts as a **high-albedo region**, regulating solar reflection and global climate.

4. Socio-Economic Services

- Source of livelihoods: **timber, herbal medicine, organic farming, tourism**.
- Home to diverse cultures, pilgrimage routes (e.g., Kedarnath, Amarnath).
- Major eco-tourism and adventure sports hub.

Ecological Threats to the Himalayas:

1. Climate Change & Glacial Retreat:

- Himalayan region is warming **2–5 times faster** than the global average
- Glaciers retreating rapidly – **Gangotri glacier** receded ~1,700m in last century.
- Risk of **Glacial Lake Outburst Floods (GLOFs)** – e.g., Kedarnath (2013).

2. Water Insecurity:

- Over **50% of Himalayan springs** are drying or seasonal (NITI Aayog, 2018).
- Affects irrigation, drinking water, and river flows.

3. Biodiversity Loss:

- Forest loss (1,072 sq. km from 2019–21); habitat degradation.
- Endangered species under threat due to deforestation, forest fires, and encroachment.

4. Unsustainable Tourism and Urbanisation

- Over-tourism without **carrying capacity studies**.
- **Joshimath subsidence** is a warning of unchecked construction.

5. Hydropower & Infrastructure Development

- 115+ large hydroelectric projects across the Himalayan basin.
- Alter natural river flow, threaten aquatic biodiversity, and increase landslide risks.

India's Policy and Institutional Responses:

1. National Mission for Sustaining Himalayan Ecosystem (NMSHE)

- Focus on glaciology, biodiversity, disaster prevention, and sustainable development.

2. Project Snow Leopard

- Census 2023 identified 718 snow leopards; ~10–15% of the global population.

3. Swadesh Darshan 2.0

- Eco-tourism promotion, emphasis on sustainable pilgrimage and cultural tourism.

4. Disaster Preparedness

- Mapping of GLOF risks, early warning systems via NDMA & MoEFCC.

5. Plastic Ban & Waste Management

- Single-use plastic ban (2022), solid waste management in pilgrimage zones.

Global and Regional Collaborations:

- **International Year of Glacier Preservation (2025)**
- **Cryosphere Decade (2025–34)**: Led by UNESCO/WMO.
- **International Centre for Integrated Mountain Development (ICIMOD):** Nepal-based intergovernmental body for Hindu Kush Himalaya.
- **Global Snow Leopard Ecosystem Protection Program (GSLEP)**: 12 countries including India.
- **International Big Cats Alliance (IBCA):** Focus on Snow Leopard and other big cats.
- **SECURE Himalaya Project:** India's GEF-funded project under the Global Wildlife Program.

India's 5-Point Global Call at Sagarmatha Sambaad:

1. **Global Mountain Alliance** for collective research, policy exchange.
2. **Technology Transfer** and capacity building.
3. **Climate Finance** tailored for mountain regions.
4. **Scientific Cooperation** on glacial and biodiversity studies.
5. **Community-based adaptation models**, integrating local knowledge.

Way Forward:

- **Mountain-centric Climate Finance** mechanisms under UNFCCC.
- **Carrying Capacity-Based Development Planning** in fragile hill towns.
- Promote **Agroforestry and Eco-Tourism** to create green livelihoods.
- Strengthen **regional scientific cooperation** through BIMSTEC, SAARC, ICIMOD.
- Focus on **Youth and Women-led conservation** in the IHR region.

<u>UPSC Mains Model Questions</u>

Q **"The Himalayas are not just a geographical feature but a critical ecological and climatic regulator for South Asia." Critically examine the ecological significance of the Himalayan Mountain system and highlight the key threats to its sustainability. Also, suggest strategic measures to address these challenges.**

UPPER SIANG HYDROPOWER PROJECT

Context:

Amid China's plans to build the world's largest dam (60,000 MW) on the Yarlung Tsangpo (Brahmaputra) near Arunachal Pradesh, India is advancing the Upper Siang Hydropower Project as a strategic countermeasure.

China's Plan:

- **Location:** Medog County, Tibet Autonomous Region, ~30 km from India border.
- **Capacity:** 60,000 MW hydropower dam on Yarlung Tsangpo (Brahmaputra).

About the Upper Siang Hydropower Project:

- **Location:** Upper Siang district, Arunachal Pradesh, on the Siang River (upper Brahmaputra).
- **Capacity:** Proposed 11,000 MW hydropower plant.
- **Developers:** Joint project by National Hydroelectric Power Corporation (NHPC) and North Eastern Electric Power Corporation (NEEPCO).
- **Strategic Importance:** India's response to China's dam project; boosts renewable energy capacity and regional development.

Local Socio-Cultural Context: The Adi Tribe

- **Who is the Adi?**
  Collective of sub-tribes: Padams, Milangs, Komkars, Minyongs, and Pasis, meaning "hill people."
  Primarily inhabit the lower part of Lower Dibang Valley district in Arunachal Pradesh.
- **Dependence on the Siang River:**
  Revere the river as Aane Siang ("mother" Siang).
  Agriculture-focused, practicing wet rice cultivation (pani kheti) and shifting cultivation.
- **Society and Culture:**
  - Patrilineal and patriarchal social structure.
  - Governed by village councils called Kebang (administrative & judicial body).
  - Religion: Donyi-Polo faith worshipping the Sun (Donyi) and Moon (Polo).
  - Unique Ritual: Motor or Pator system — ritual lockdowns to find wild herbs during epidemics.

- **Festivals:**
  - Solung (1st September)
  - Etor (15th May)
  - Aaran (7th March)
- **Language:**
  Tibeto-Burman origin, roots tracing back to southern China around the 16th century.
- **Economic & Cultural Significance:**
  Mithun (a bovine animal) holds socio-religious value. The Adi rely heavily on agriculture due to limited arable land in hilly terrain.

Model UPSC Mains Question:

Q **Critically examine the strategic and socio-environmental significance of the Upper Siang Hydropower Project in the context of India-China water security dynamics. Discuss the potential impact on the indigenous Adi tribe and measures to balance development with local ecological and cultural concerns.**

KEN BETWA LINK PROJECT

Context:

PM Modi recently laid the foundation stone for the Ken Betwa River Linking National Project, India's first river interlinking initiative under the National Perspective Plan for interlinking rivers.

About the Ken-Betwa Link Project (KBLP):

- Transfers water from the Ken River to the Betwa River, both tributaries of the Yamuna.
- **Ken-Betwa Link Canal length:** 221 km (including a 2 km tunnel).
- **Expected irrigation:** 10.62 lakh hectares (8.11 lakh ha in Madhya Pradesh, 2.51 lakh ha in Uttar Pradesh).
- **Drinking water supply:** ~62 lakh people.
- **Power generation:** 103 MW hydropower + 27 MW solar power.

Regional Importance:

- Targets Bundelkhand region (parts of Jhansi, Banda, Lalitpur, Mahoba in UP; Tikamgarh, Panna, Chhatarpur in MP) which suffers from water shortages due to erratic rainfall and groundwater depletion.

Key Project Components:

- **Dhaudhan Dam:** 77-meter tall, 2 km wide dam on Ken River within Panna Tiger Reserve.

Rivers Involved:

- **Ken River:** Originates in Kaimur Range, Madhya Pradesh; flows through Panna Tiger Reserve; merges with Yamuna in Banda district, UP. Known for scenic beauty and biodiversity (especially tigers).
- **Betwa River:** Originates in Vindhya Range, Madhya Pradesh; joins Yamuna in Hamirpur district, UP. Important dams include Rajghat, Paricha, and Matatila supporting irrigation and hydropower.

Model UPSC Mains Question:

Q Examine the potential benefits and challenges of the Ken Betwa Link Project in addressing water scarcity in the Bundelkhand region. Discuss the environmental concerns related to the project, especially with respect to the Panna Tiger Reserve, and suggest measures to ensure sustainable development.

MANGANESE WATER CONTAMINATION

Context:

A study has revealed significant manganese (Mn) contamination in water as a contributing factor to rising cancer cases in Bihar's Gangetic region.

About Manganese:

- Fifth-most abundant metal on Earth; hard, brittle, silvery metal found mainly in oxides, carbonates, and silicates.
- Essential trace element for human health, required in small quantities for bone formation and enzyme activity.
- Excessive manganese in water poses serious health risks.

Geological Formation in India:

- Manganese ore deposits mostly metamorphosed bedded sedimentary deposits linked to the Gondite Series.

Water Quality Standards:

- Indian Standards for Drinking Water (IS 10500:2012):
  - Acceptable limit: 100 µg/L
  - Permissible limit: 300 µg/L
- Elevated levels reported in blood samples, e.g., 6,022 µg/L in a liver cancer patient.

Key Geographical Hotspots in India:

- Madhya Pradesh
- Maharashtra (Vidarbha Region)
- Odisha

Sources of Manganese:

- **Natural:** Weathering of manganese-rich rocks releasing manganese into groundwater.
- **Anthropogenic:**
  - Industrial mining involving manganese ore.
  - Agricultural runoff (fertilizers and pesticides).
  - Urban runoff (stormwater and sewage).

Model UPSC Mains Question:

Q **Analyze the causes and health implications of manganese contamination in groundwater, with special reference to Bihar's Gangetic region. Discuss the steps that can be taken to mitigate manganese pollution and safeguard public health.**

LAKE-EFFECT SNOW

Context:

Recently, lake-effect snow blowing in from the Great Lakes blanketed parts of Michigan, Ohio, Pennsylvania, and New York.

About Lake-Effect Snow:

- Common in the **Great Lakes region** during late fall and winter.
- Occurs when **cold air**, usually from Canada, moves over the **relatively warmer and unfrozen Great Lakes**.
- As cold air crosses the lakes:
  - It picks up **moisture and heat**.
  - The moist air rises, forming **clouds**.
  - Snow then falls as the air cools.

Formation Characteristics:

- **Cloud Streets:** Linear snow-producing clouds pushed onshore by wind.
- **Localized Snowfall:** Heavy snow in one area, clear skies just miles away.
- **Key Influencing Factors:**
  - **Wind Speed & Direction:** Affect width and direction of snow bands.
  - **Topography:** Influences snowfall rate and accumulation.

Model UPSC Mains Question:

Q **What is lake-effect snow? Explain the meteorological conditions necessary for its formation and its localized impact. How can such phenomena influence weather forecasting and disaster preparedness in snow-prone regions?**

WORLD SOLAR REPORT SERIES

Context:

The **3rd edition** of the World Solar Report Series was released at the **7th Assembly of the International Solar Alliance (ISA)**.

About the World Solar Report Series:

- **Launched:** 2022
- **Purpose:** Offers a concise and comprehensive overview of global progress in solar technology, investment trends, and sustainability efforts.
- **2024 Edition:** Includes 4 major reports:
    1. World Solar Market Report
    2. World Investment Report
    3. World Technology Report
    4. Green Hydrogen Readiness Assessment for African Countries

Key Findings:

World Technology Report:

- Solar PV module efficiency record: **24.9%**
- **88% reduction** in silicon usage since 2004
- **90% decline** in utility-scale solar PV costs

World Solar Market Report:

- Global solar capacity rose from **1.22 GW (2000)** to **1418.97 GW (2023)**
- Average **40% annual growth rate**

Green Hydrogen Readiness Assessment (Africa):

- Highlights the role of **green hydrogen** in decarbonizing African industries
- Supports energy transition and energy security

World Investment Report:

- Global energy investments up from **$2.4 trillion (2018)** to **$3.1 trillion (2024)**
- Indicates rising investor confidence in sustainable and renewable energy

Model UPSC Mains Question:

Q **Discuss the significance of the World Solar Report Series in tracking global solar energy progress. How can such multilateral initiatives under the International Solar Alliance support developing countries in achieving a just energy transition?**

COASTAL HARDENING

Context:

A new study has revealed that **33% of the world's sandy beaches** have undergone **coastal hardening** due to human-made structures like roads and seawalls.

About Coastal Hardening:

- Refers to the construction of **rigid, semi-impermeable structures** along coastlines.
- Alters the **natural shoreline dynamics**, obstructs beach retreat, and interferes with landward translation of sandy beaches.
- Includes:
    - **Seawalls**, harbours, roads, highways
    - **Railway revetments**, urban infrastructure
    - Impervious surfaces that reduce natural absorption and flow

Global Trends in Coastal Hardening:

- **Bay of Bengal:** Highest with **84%** hardened coastline
- **Western & Central Europe:** 68%
- **Mediterranean:** 65%
- **Western North America:** 61%
- **East Asia:** 50%

Impacts on Ecosystems:

Habitat Disruption:

- Destruction of **wetlands, mangroves, coral reefs**, and **beaches**

Invasive Species Risk:

- Ports serve as hubs for **invasive marine species**
- Ships transport organisms via hulls and ballast water
- Artificial structures support non-native species colonization

Beach Loss:

- Erosion of sandy beaches
- Loss of **natural storm buffers** and habitat for coastal flora/fauna

Coastal Squeeze:

- Occurs when **hard structures restrict tidal zones**
- Aggravated by **sea-level rise**
- Leads to **biodiversity loss** and ecological imbalance

Model UPSC Mains Question:

Q **What is coastal hardening? Examine its ecological consequences, especially in the context of climate change and sea-level rise. Suggest sustainable alternatives to balance coastal development with ecosystem preservation.**

SANTA ANA WINDS

Context:

Santa Ana winds are significantly increasing the risk of **wildfires** and causing damage across affected regions of **California**.

About Santa Ana Winds:

- **Type:** Strong, dry, hot **downslope winds**
- **Region Affected:** Coastal **Southern California** and **northern Baja California**
- **Named After:** Santa Ana Canyon (Southern California)
- **Similar Winds:** Foehn winds (Alps), Chinook winds (Rocky Mountains)

Origin and Mechanism:

- Form when a **high-pressure system** settles over the **Great Basin** (between Rockies and Sierra Nevada)
- Winds flow **clockwise** around the high-pressure area, moving **southwest**
- Air descends over the **Sierra Mountains**, drying and accelerating due to compression
- Wind speeds increase further as they funnel through **valleys and canyons**
- Typical wind speeds: **95–130 km/h**

Seasonality:

- Most frequent from **late September to May**
- Usually last **2–3 days**, occasionally up to a **week**

Impact on Wildfires:

- **Low humidity** dries vegetation, aiding **initial ignition**
- Winds act like a **hair dryer**, stripping moisture from plants
- High wind speeds help **spread fires rapidly**
- **Example:** 2017 Thomas Fire, one of California's largest, was worsened by Santa Ana winds

Model UPSC Mains Question:

Q **What are Santa Ana winds? Discuss their formation mechanism and the role they play in exacerbating wildfire risks in the western United States. How can better understanding of such regional wind systems aid disaster preparedness and mitigation strategies?**

EMISSIONS FROM ARCTIC TUNDRA

Context:

The **Arctic Tundra ecosystem**, once a major carbon sink, has now become a **source of CO_2 and CH_4 (methane)** emissions due to climate-induced change.

About Arctic Tundra:

- **Biome Type:** Vast, treeless **permafrost biome** encircling the Arctic Ocean.
- **Latitude Range:** Between **66.5°N to 75°N**
- **Countries Covered:** Alaska (USA), Canada, Greenland, Scandinavia, Russia

Climate & Geography:

- **Precipitation:** < 25 cm annually (considered a **cold desert**)
- **Winters:** Long, bitterly cold (**below -30°C**)
- **Summers:** Short and cool (**3–12°C**)
- **Soil:** Mostly **permafrost**, with a thin **active layer** in summer
- **Vegetation:** Low shrubs, grasses, mosses, lichens
- **Wildlife:** Arctic foxes, polar bears, reindeer, musk oxen, lemmings, wolves

Reasons Behind Emissions:

Thawing Permafrost:

- Arctic warming at **4x global rate**
- Thawing activates **soil microbes**, breaking down organic matter
- Releases **CO_2 and methane (CH_4)** into the atmosphere

Increased Wildfires:

- Arctic sees more **frequent and intense wildfires**
- Fires release GHGs and accelerate **permafrost thaw**
- Smoke deposits dark particles, reducing surface albedo and increasing heat absorption

Model UPSC Mains Question:

Q **Discuss the causes and implications of the Arctic Tundra turning from a carbon sink into a carbon source. How does this transformation influence global climate feedback loops and what strategies can help mitigate such emerging climate threats?**

HYDROTHERMAL VENT

Context:

Indian oceanographers have captured an image of an **active hydrothermal vent** located **4,500 metres below** the surface of the Indian Ocean.

About Hydrothermal Vents:

- **Definition:** Fissures on the ocean floor that release **geothermally heated, mineral-rich fluids**.
- **Location:** Found near **mid-ocean ridges**, ocean basins, **volcanically active zones**, and **hotspots**.
- **Formation:**
  - Seawater seeps through cracks in the ocean crust.
  - It is **superheated by underlying magma**.
  - The water reemerges carrying **dissolved minerals** and gases.

Types of Vents:

Black Smokers:

- Emit **dark-coloured fluid** rich in **metal sulfides** (e.g. iron, copper) Appearance: Dense black plumes

White Smokers:

- Emit **lighter-coloured fluid** rich in **barium, calcium, and silicon**
- Lower temperatures than black smokers

Key Features:

- Water temperatures: Can reach **over 320°C**
- Vents may remain active from **hundreds to 30,000 years**

Significance:

Mineral Content:

- Rich in **silver, gold, manganese, cobalt, zinc**
- Example: Solwara 1 project (Pacific Ocean – deep-sea mining potential)

Life Support:

- Home to unique organisms: **tubeworms, clams, shrimp, octopods**
- Thrive on **chemosynthesis**, not photosynthesis

Origin of Life:

- Mimic early Earth conditions
- Provide clues to **abiogenesis** (origin of life on Earth)

Astrobiology:

- Analogs for extraterrestrial life in **Europa (Jupiter)** & **Enceladus (Saturn)**

Carbon Cycle Role:

- Influence **carbon sequestration**, chemical transformations in the deep ocean.

India's Perspective:

- Under **Deep Ocean Mission**, the **Samudrayaan Mission** is exploring deep-sea biodiversity and mineral wealth.
- **Focus area: Central Indian Ocean Basin (CIOB)** for **polymetallic nodules**

Model UPSC Mains Question:

Q What are hydrothermal vents? Explain their role in ocean ecology, carbon cycling, and the origin of life. How can India's Deep Ocean Mission leverage such discoveries for strategic and scientific gains?

SACRED GROVES

Context:

The **Supreme Court** has issued directions regarding the **identification of sacred groves** such as Orans by the **Rajasthan Government**, in line with the landmark **T.N. Godavarman Judgment (1996)**.

About Sacred Groves:

- **Definition:** Patches of forest or natural vegetation preserved due to **religious and spiritual beliefs** of indigenous/local communities.
- Often considered **sacred spaces**, where rituals, cultural practices, and taboos ensure their protection.
- Seen as **inviolable**, leading to **long-term conservation**.

Community Protection:

- Maintained and protected by **local or tribal communities** based on customs and beliefs.
- Belief in **spiritual guardianship** (deities, spirits, ancestors) discourages exploitation.
- Symbol of **community-driven conservation ethics**.

Estimated Presence:

- India is home to **100,000–150,000 sacred groves** (IUCN estimate).

- Serve as **biodiversity refuges**, conserving endemic and rare species of flora and fauna.

Ecological & Cultural Importance:

Biodiversity Hotspots:

- Preserve rare medicinal plants, endangered species, and unique ecosystems.

Cultural Landscapes:

- Interwoven with **folk traditions, festivals, taboos**, and oral histories.

Climate Buffering:

- Aid **groundwater recharge**, microclimate regulation, and **soil conservation**.

Notable Example:

- **Living Root Bridges (Jingkieng Jri)** in **Meghalaya**
  - Made by training the roots of rubber fig trees
  - Part of **UNESCO Tentative World Heritage List**
  - Represent a fusion of **ecological engineering and cultural reverence**

Model UPSC Mains Question:

Q What are sacred groves, and how do they contribute to biodiversity conservation in India? Discuss their relevance in modern environmental governance and the role of traditional knowledge in sustaining them.

INDIA LAUNCHED THE WORLD'S FIRST GREEN STEEL TAXONOMY

Context:

The **Union Ministry of Steel** has launched the **world's first Green Steel Taxonomy** to promote sustainability and low-carbon practices in India's steel industry.

About Green Steel Taxonomy:

- A framework to define and **certify "green steel"** based on its **carbon emission intensity**.
- Aims to **standardize emission metrics**, promote **low-emission technologies**, and accelerate the **decarbonization of the steel sector**.

Definition of Green Steel:

- Steel with **CO_2 equivalent (CO_2e) emission intensity** of **less than 2.2 tonnes per tonne of finished steel (tfs)** is considered "green."

Greenness Rating System:

⭐ Rating	CO_2e Emission Intensity (t-CO_2e/tfs)
⭐⭐⭐⭐⭐	Less than **1.6**
⭐⭐⭐⭐	**1.6 – 2.0**
⭐⭐⭐	**2.0 – 2.2**
❌ Not Rated	Above **2.2** (Not eligible for green label)

Other Key Features:

- **Periodic Review:** Rating thresholds will be **reviewed every 3 years**.
- **Emission Scope Covered:**
  - Scope 1 (direct emissions)
  - Scope 2 (indirect electricity use)
  - Limited Scope 3 (excludes mining, transport, downstream use)
- **Certification Frequency:** Annual (based on financial year), with more frequent options based on MRV (Measurement, Reporting & Verification).
- **Nodal Agency: National Institute of Secondary Steel Technology (NISST)**

Model UPSC Mains Question:

Q Discuss the significance of India's Green Steel Taxonomy in the global context of industrial decarbonization. How can such initiatives support India's climate goals under the Paris Agreement and enhance sustainable manufacturing?

INDIA CONDUCTS FIRST-EVER GANGES RIVER DOLPHIN TAGGING

Context:

India has conducted the **world's first satellite tagging** of a **Ganges River Dolphin** under **Project Dolphin**, enhancing scientific understanding of the species' behavior and movement.

About the Tagging Exercise:

- **Location:** Assam
- **Lead Agencies:** Wildlife Institute of India (WII), Assam Forest Department, NGO Aaranyak
- **Guided by:** Ministry of Environment, Forest and Climate Change (MoEFCC)
- **Funded by: National CAMPA Authority**
- **Significance:** First such tagging of **Ganges River Dolphin** globally

About Project Dolphin:

- **Launch Year:** 2020 by MoEFCC
- **Aim:** Conservation of oceanic and freshwater dolphins using modern tech
- **Focus Areas:**
  - Population assessment
  - Habitat conservation
  - Anti-poaching efforts

Feature	Details
Other Names	Susu, Tiger of the Ganga
Range	Endemic to Indian subcontinent: Ganga-Brahmaputra-Meghna & Karnaphuli
Population	~90% of global population found in India
Respiration	Uses a blowhole; surfaces every few minutes to breathe
Physical Traits	Long snout, large flippers, rounded body, no lens (nearly blind)
Skin Color	Chocolate brown at birth → grey-brown in adults
National Status	**India's National Aquatic Animal**
Conservation Status	IUCN: **Endangered** 🌍 | WPA: **Schedule I** IN | CITES: **Appendix I** 📜

Ganges River Dolphin (Platanista gangetica):

Why This Matters:

- Helps track **movement, breeding patterns, threats** like pollution or river infrastructure.
- Aids in **policy decisions** regarding river conservation and species protection.
- Demonstrates India's leadership in **aquatic biodiversity conservation**.

Model UPSC Mains Question:

Q **Discuss the significance of satellite tagging in the conservation of aquatic species, with reference to India's recent efforts in protecting the Ganges River Dolphin. How can such technology-based initiatives strengthen biodiversity conservation policies in the country?**

SPONGE CITY

Concept Origin:

- Introduced in **2013** by **Prof. Kongjian Yu** (Peking University, China)
- **Core principle:** Work with nature rather than fighting against it
- Adopted in cities like **Shanghai** (China) and **Auckland** (New Zealand)

What is a Sponge City?

A **Sponge City** is an **urban area designed to absorb, store, and purify rainwater** using **natural or green infrastructure**, thus reducing urban flooding and improving water sustainability.

Key Features:

Natural Element	Function
Trees & Parks	Increase water infiltration, reduce runoff
Lakes & Ponds	Temporarily store excess water
Green Roofs	Absorb rainwater, regulate temperature
Permeable Pavements	Allow water to seep into the ground
Rain Gardens/Bio-swales	Filter and redirect stormwater

Benefits:

1. **Flood Mitigation**: Reduces the pressure on drainage systems
2. **Water Conservation**: Enhances groundwater recharge, supports water supply during drought
3. **Climate Resilience**: Adapts to both flood and drought conditions
4. **Improved Air Quality**: Vegetation helps absorb pollutants
5. **Urban Livability**: Increases green spaces → better health and recreation
6. **Pollution Control**: Filters stormwater before it reaches water bodies

Model UPSC Mains Question:

Q What is the concept of a Sponge City? Discuss how this concept can be integrated into India's urban planning strategy to address increasing instances of urban flooding.

UNFCCC COP29 Initiatives and Declarations (Baku, Azerbaijan, 2024)

About COP:

- COP stands for Conference of the Parties, the supreme body of the UNFCCC.
- It is an annual meeting to assess progress and update commitments (NDCs).
- COP30 is scheduled to be held in Belém, Brazil in November 2025.

Key COP29 Initiatives:

Initiative / Declaration	Description & Partners	India's Position
Baku Harmoniya Climate Initiative for Farmers	Launched with FAO; recognizes farmers as key climate agents.	Supported
Baku Initiative for Climate Finance, Investment and Trade (BICFIT)	Co-facilitated by UNCTAD & UNDP; links finance, trade & climate.	Supported
Baku Dialogue on Water for Climate Action	Collaboration on water issues and climate with UNEP, UNECE, WMO.	Supported
Climate Finance Action Fund (CFAF)	Supports climate projects in developing countries; $1B target.	Supported
Continuity Coalition for Climate and Health	Integrates health into climate action; with WHO, UAE, Egypt, UK, Brazil.	Supported
Declaration on Green Digital Action	Uses digital technology for climate & sustainable development; with ITU.	Supported
Global Energy Storage and Grids Pledge	Target: 1,500 GW energy storage by 2030; India did not endorse.	Not endorsed
Green Energy Pledge: Green Energy Zones and Corridors	Promotes renewable hubs with UNIDO, UNECE, UNESCAP.	Supported
Global Matchmaking Platform (GMP)	UNIDO initiative to decarbonize heavy industries in developing countries.	Supported

Hydrogen Declaration	Accelerates clean hydrogen production; non-binding. India did not sign.	Not signed
Reducing Methane from Organic Waste Declaration	UNEP & CCAC-led, targets methane reduction. India not a signatory.	Not signed

Other Important Initiatives:

Initiative	Description
COP29 Declaration on Enhanced Climate Action in Tourism	Engage tourism sector to reduce emissions.
Global Energy Efficiency Alliance	Launched by UAE; aims to double energy efficiency by 2030.
Hydro4NetZero-LAC Initiative	Sustainable hydropower development in Latin America & Caribbean.
Global Alliance for Pumped Storage (GAPS)	Promotes pumped storage technology for energy stability.

Summary of India's Position"

- Supported initiatives that align with sustainable finance, agriculture, water, health, and digital technology.
- Did not endorse global pledges on energy storage and hydrogen, citing national priorities and strategies.
- Did not sign methane reduction from organic waste declaration.

Significance:

- COP29 furthered global cooperation on climate finance, adaptation, and technology transfer.
- Emphasized cross-sectoral approaches involving farmers, health, water, and digital technology.
- Highlighted emerging climate solutions like green energy zones, hydrogen, and methane reduction.

Global Climate Finance Initiatives

Context:

Developing countries have expressed disappointment over the progress of the enhanced New Collective Quantified Goal (NCQG) on climate finance.

New Collective Quantified Goal (NCQG):

- A key initiative under the Paris Agreement aimed at scaling up climate finance for developing countries.

- Proposed at COP21 to replace the earlier $100 billion annual mobilization commitment made in 2009 (Copenhagen Summit), which was not fully met.
- Focuses on empowering vulnerable developing countries with resources for clean energy, adaptation, and climate-resilient infrastructure.

Climate Finance Definition (UNFCCC):

Funding (local, national, or transnational) from public, private, and alternative sources to support mitigation and adaptation efforts in climate-vulnerable developing nations.

Major Global Financial Mechanisms under UNFCCC:

- **Adaptation Fund (2001):** Finances adaptation projects, funded by 5% of proceeds from the new UNFCCC market mechanism (Article 6.4 of Paris Agreement).
- **Special Climate Change Fund (SCCF) (2001):** Finances adaptation, technology transfer, capacity building, and energy/transport projects; managed by the Global Environment Facility (GEF).
- **Least Developed Countries Fund (LDCF) (2001):** Supports Least Developed Countries in preparing and implementing National Adaptation Programmes of Action (NAPAs), administered by GEF.
- **Green Climate Fund (GCF) (2010):** Established at COP16 with a pledge of $100 billion per year by developed countries to aid developing countries in meeting their NDCs.
- **Loss and Damage Fund (LDF) (2022):** Created at COP27, operationalized at COP28, to financially assist vulnerable countries facing irreversible climate impacts. Hosted temporarily by the World Bank, with the Philippines hosting its board.

India's Steps to Mobilize Climate Finance:

- **National Adaptation Fund for Climate Change (NAFCC):** Launched in 2015 to support climate adaptation projects nationally.
- **Priority Sector Lending:** Financing renewable energy projects to accelerate sustainable energy transition.
- **Green Bonds & Deposits:** First green bond issued by Yes Bank in 2015 for environmentally friendly projects; sovereign green bonds announced in Union Budget 2022-23.
- **Sustainable Finance Group (SFG):** Created under RBI to promote sustainable finance.

- **Network for Greening of Financial Systems (NGFS):** RBI joined this global network to incorporate sustainability in financial regulation.

Model UPSC Mains Question

Q Discuss the significance of the New Collective Quantified Goal (NCQG) on climate finance in empowering developing countries. Critically examine the challenges faced in meeting climate finance commitments and evaluate India's efforts to mobilize climate finance domestically.

Just Transition

Context:

At COP29, India emphasized the need for global climate justice and equitable action during the Second Annual High-Level Ministerial Round Table on Just Transition.

About Just Transition:

- Defined by the International Labour Organization (ILO) as the process of moving from high-carbon, unsustainable economic systems to low-carbon, sustainable ones in a way that is fair, inclusive, and equitable for all affected stakeholders.

Key Elements of Just Transition:

- **Equity:** Protect the rights and livelihoods of workers and communities dependent on high-carbon industries.
- **Inclusion:** Ensure all stakeholders — workers, governments, industries, and civil society — are involved in decision-making.
- **Sustainability:** Align economic and social systems with greenhouse gas emission reduction and natural ecosystem conservation goals.

Background:

- The concept was formalized in the Just Transition Declaration at COP26 and reinforced in subsequent climate negotiations.

Initiatives for Just Transition in India:

- **Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY):** Supports development programs in mining-affected areas via District Mineral Foundations (DMFs).
- **District Mineral Foundations (DMFs):** Non-profit trusts created by state governments under the Mines and Minerals (Development and Regulation) Amendment Act, 2015, to aid mining-affected districts.

- **Production-Linked Incentive (PLI) Scheme – National Programme on High Efficiency Solar PV Modules:** Promotes domestic manufacturing of high-efficiency solar photovoltaic modules.
- **Global Collaboration:** Partnership with Asian Development Bank to establish a Just Transition Worker Support Facility for coal-dependent regions.
- **National Clean Energy Fund (NCEF):** Funded by a coal cess, it finances clean energy projects and ventures in India.

National Biodiversity Strategy and Action Plan (NBSAP)

Context:

India unveiled its updated NBSAP for 2024-2030 at COP16 of the UN Convention on Biological Diversity (UNCBD).

About NBSAP:

- A national framework aimed at biodiversity conservation, sustainable use of natural resources, and fair benefit-sharing from genetic resources.
- Article 6 of UNCBD requires each signatory country to prepare its own NBSAP.
- It is the main tool to mainstream biodiversity and implement the UNCBD nationally.

Key Highlights of India's Updated NBSAP (2024-2030):

- **Approach:** Adopts a 'Whole of Government' and 'Whole of Society' approach aligned with the Kunming-Montreal Global Biodiversity Framework (KMGBF). Goal: halt and reverse biodiversity loss by 2030 and live in harmony with nature by 2050.
- **National Biodiversity Targets (NBTs):** 23 targets focused on reducing biodiversity threats, sustainable resource use, and enhancing implementation tools.
- **Implementation:** Led by the Ministry of Environment, Forest and Climate Change (MoEFCC).
- **Capacity Building:** Focus on need assessments, target group identification, expert involvement, and skill development to strengthen local capacities.
- **Resource Mobilization:** India leads in implementing the Biodiversity Finance Initiative (BIOFIN), a global partnership to improve biodiversity finance management.
- **Other Features:** Promotes collaborative governance and bottom-up approaches involving local communities and multiple sectors.

Biological Diversity Act, 2002:

Aim: Aligns India with the UNCBD.

Goals:

- Protect and conserve biological diversity.
- Promote sustainable use of biological resources.
- Ensure fair and equitable benefit-sharing from use of biological resources.

Institutional Structure:

- **National Level:** National Biodiversity Authority (NBA), headquartered in Chennai.
- **State Level:** State Biodiversity Boards (SBBs) — not set up in Union Territories.
- **Local Level:** Biodiversity Management Committees (BMCs).

Approvals Required For:

- Foreign nationals seeking access to biological resources — NBA approval mandatory.
- Indian entities transferring research/materials to foreign parties — NBA approval needed.
- Intellectual Property Rights (IPR) — NBA approval required before patent filing involving biological materials or traditional knowledge from India.

2023 Amendments:

- AYUSH practitioners and traditional knowledge holders are exempt from Access and Benefit Sharing (ABS) regulations.
- Criminal penalties replaced by fines.

Biological Diversity Rules, 2024:

- NBA Chairperson appointed by the Central Government for a three-year term.

Functions of National Biodiversity Authority (NBA):

- Administers the National Biodiversity Fund (NBF).
- Approves biodiversity-related agreements.
- Supports state biodiversity boards.
- Maintains databases on biological resources and traditional knowledge.

Penalties:

- Range from ₹1 lakh to ₹50 lakh.
- Fines collected go toward biodiversity conservation funds.

Question:

Q "The updated National Biodiversity Strategy and Action Plan (NBSAP) 2024-30 adopts a 'Whole of Government' and 'Whole of Society' approach to halt biodiversity loss and promote sustainable use of resources."

GLACIAL LAKE OUTBURST FLOODS (GLOFs)

Context:

A recent report by the Central Water Commission (CWC) highlights significant expansion of glacial lakes and other water bodies in the Himalayas.

Key Findings of the Report:

- The surface area of glacial lakes in India increased by 33.7% between 2011 and 2024.
- Glacial lakes and water bodies in the Himalayan region (including Bhutan, Nepal, and China) expanded by 10.81% in the same period, mainly due to climate change.
- Regions with notable expansion include Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh.

About Glacial Lakes and GLOFs:

- Glacial lakes are water bodies formed from melting glacial ice, typically in depressions or basins created by glaciers.
- They are classified into four types based on formation: moraine-dammed, ice-dammed, erosion, and others.
- Glacial Lake Outburst Floods (GLOFs) occur when a moraine or ice dam holding a glacial lake fails, releasing large volumes of water suddenly.

Key Features of GLOFs:

- Sudden and sometimes cyclic water releases.
- Rapid events lasting hours to days.
- Cause large downstream river discharges.

Major Causes of GLOFs:

- **Glacial surging:** rapid glacier movement over a short period.
- **Moraine dam instability:** collapse of loose, unstable moraines.
- **Ice dam failure:** weakening due to thermal stress, water pressure, or melting.
- **Seismic activity:** tectonic movements destabilizing glacial dams.
- **Human activity:** urbanization, mining, deforestation, hydropower projects, and greenhouse gas emissions disrupt natural drainage and increase GLOF risks.

About Central Water Commission (CWC):

- Premier technical organization for water resources in India, headquartered in New Delhi under the Ministry of Jal Shakti.
- Established in 1945 as Central Waterways, Irrigation and Navigation Commission (CWINC), advised by Dr. B. R. Ambedkar.
- **Functions:**
    - **Divided into three wings:** Designs and Research, River Management, Water Planning and Projects.
    - Coordinates with state governments on flood control, irrigation, navigation, drinking water supply, and hydropower.
    - Conducts investigations, construction, and project execution.
- Chairman acts as an Ex-Officio Secretary to the Government of India.

TSUNAMI READY VILLAGES

Context:

Twenty-four coastal villages in Odisha have been recognized as 'Tsunami Ready' during the 2nd Global Tsunami Symposium held in Indonesia.

About Tsunami Ready Recognition Programme (TRRP):

- The TRRP, run by the Intergovernmental Oceanographic Commission (IOC) of UNESCO, aims to build resilient coastal communities through awareness and preparedness to protect lives and property from tsunamis.
- **Objective:** To ensure community preparedness and minimize losses from tsunamis.
- **Indicators:** Communities must meet 12 readiness indicators across Assessment, Preparedness, and Response to earn the 'Tsunami Ready' status, which is renewable every four years.
- **Collaborative Effort:** The programme involves national and local agencies, government bodies, scientists, community leaders, and the public.
- **Voluntary Programme:** It focuses on performance-based readiness outcomes rather than mandatory regulations.
- Tsunami Ready recognition does not imply a community is tsunami proof; rather, it acknowledges that the community has adopted mitigation measures to cope with tsunami risks
- In India, the Tsunami Ready Programme is overseen by the National Tsunami Ready Board, established by the Ministry of Earth Sciences.

About Tsunamis:

- Tsunamis are a series of massive waves caused by underwater disturbances such as earthquakes, volcanic eruptions, landslides, or rock falls near the coast.
- The word "tsunami" comes from Japanese: "tsu" means harbour and "nami" means wave.

Characteristics of Tsunamis:

- **Speed:** Tsunamis travel at speeds exceeding 500 miles per hour in deep waters, slowing down to 20 to 30 miles per hour near shallow coastal areas.
- **Series of Waves:** Tsunamis consist of multiple waves arriving at intervals. The first wave is not always the most destructive; larger waves may follow, making tsunamis unpredictable.
- **Wave Behavior:** As tsunamis approach the shore, their wavelength decreases while wave height increases. The speed depends on the ocean's depth rather than the distance from the source.
- **Long Period:** The time interval between tsunami waves ranges from 10 minutes to 2 hours, which is much longer than normal ocean waves that have periods of 5 to 20 seconds.

Model UPSC Mains Question:

Q **"Discuss the significance of the Tsunami Ready Recognition Programme in building coastal resilience in India. How does community preparedness play a crucial role in mitigating tsunami risks?"**

Net-Zero Banking Alliance (NZBA)

- **Overview**: NZBA is a global bank-led coalition convened by the United Nations Environment Programme Finance Initiative (UNEP FI), committed to aligning banks' financing activities with net-zero greenhouse gas emissions by 2050.
- **Objective**: Support the 1.5°C global warming limit by ensuring banks align their lending and investment portfolios with science-based decarbonization pathways.
- **Significance**: It is the largest climate-focused banking coalition with 144 banks from 44 countries.
- **Status**: Recently, major Wall Street banks have exited NZBA, raising concerns about the coalition's future impact.
- **Indian Banks**: No Indian banks are members of NZBA yet.
- **Parent Organization (UNEP FI)**:

- Founded in 1992, based in Geneva.
- Connects financial institutions with the UN to promote sustainability in banking, insurance, and investment sectors.
- Oversees key sustainability frameworks like the Principles for Responsible Banking (PRB), Principles for Sustainable Insurance (PSI), and Principles for Responsible Investment (PRI).
- Yes Bank is a member of PRI but not NZBA.

Model UPSC Mains Question:

Q **"Critically evaluate the role of the Net-Zero Banking Alliance (NZBA) in promoting sustainable finance globally. What challenges do initiatives like NZBA face, particularly in the context of banking sector participation?"**

Blue Flag Beach Certification

- **What is it?**
  A prestigious international eco-label awarded to beaches, marinas, and sustainable boating operators that meet strict environmental, educational, safety, and accessibility standards.
- **Administered by:**
  Foundation for Environmental Education (FEE), based in Copenhagen, Denmark.
- **Origin:**
  Started in France in 1985; adopted across Europe from 1987 and outside Europe since 2001 (starting with South Africa).
- **Significance:**
  Indicates high standards of cleanliness, environmental management, safety, and public education, aligned with SDG 14 (Life Below Water).
- **Certification Criteria:**
  There are 33 criteria in four main areas:
  - Environmental Education & Information
  - Bathing Water Quality
  - Environmental Management
  - Safety & Services
- **India's Blue Flag Beaches:**
  India currently has 13 beaches certified under the Blue Flag Programme, including:
  - Shivrajpur (Gujarat)
  - Ghoghla (Diu)

- Kasarkod & Padubidri (Karnataka)
- Rushikonda (Andhra Pradesh)
- Golden Beach (Odisha)
- Radhanagar (Andaman and Nicobar)
- Kovalam (Tamil Nadu)
- Eden (Puducherry)
- Minicoy Thundi Beach & Kadmat Beach (Lakshadweep)
- Kappad & Chal (Kerala) — recently added

- **India's Coastal Management Initiatives:**
  - **BEAMS Program:** Launched by Ministry of Environment, Forest, and Climate Change to promote sustainable coastal tourism and beach management.
  - **Integrated Coastal Zone Management (ICZM):** Implemented by Society of Integrated Coastal Management (SICOM) focusing on coastal environment protection and eco-friendly tourism.

Boreal Forests (Taiga)

Context:

A recent study shows nearly half of global boreal forests are undergoing major changes due to climate change, increasing their vulnerability to forest fires and affecting their carbon sink function.

What are Boreal Forests?

- **Definition:** Largest forest biome in the Northern Hemisphere, also called taiga.
- **Location:** Exclusively between 45° and 70° north latitude across Canada, Russia, Scandinavia, and Alaska.
- **Coverage:** Approximately 11% of Earth's land surface.
- **Significance:** Second only to the Amazon in ecological importance for carbon storage and oxygen production.

Climate and Vegetation:

- **Temperature:**
  - **Winters:** Long, harsh, extremely cold (down to -40°C).
  - **Summers:** Short, mild (10-20°C).
- **Precipitation:** 300-850 mm annually, mostly as snow.
- **Vegetation:** Dominated by coniferous trees like spruce, fir, pine, and larch.
- **Soil:** Acidic, nutrient-poor with a thick litter layer due to slow organic decomposition.

Wildlife and Ecosystem:

- **Large mammals:** Moose, caribou, bears, wolves.
- **Predators:** Lynx, foxes.
- **Other fauna:** Squirrels, snowshoe hares, owls.
- **Ecosystem traits:**
  - Harsh climate limits biodiversity.
  - Plays a crucial role in carbon sequestration and climate regulation.

Indigenous Hydrogen Train Engine — India

Context:

India developed the world's most powerful hydrogen-powered train engine under the Hydrogen for Heritage project launched by the Ministry of Railways in 2023.

Key Features:

- **Power:** 1,200 horsepower — significantly higher than 500-600 hp engines from countries like Germany, France, Sweden, and China.
- **Design & Manufacturing:**
  - Designed by RDSO (Research, Design, and Standards Organization), Lucknow.
  - Manufactured by Integral Coach Factory, Chennai.
- **Pilot Route:** Planned between Jind and Sonipat.
- **Versatility:** Technology adaptable to trucks, tugboats, and other transport.
- **Government Support:**
  - Union Budget 2023-24 allocated funds for 35 hydrogen fuel cell trains.
  - Initiative aims to retrofit Diesel-Electric Multiple Unit (DEMU) trains with hydrogen fuel cells.
- **Benefits:**
  - Promotes green transport and supports India's net-zero carbon goals by 2030.
  - Eliminates need for electrified routes and overhead cable installation, ideal for non-electrified tracks.
- **Challenges:**
  - High initial investment for green hydrogen production and infrastructure.
  - Costs expected to decrease with large-scale adoption.

Kampala Declaration (2026–2035)

Context:

Adopted at the Extraordinary African Union Summit in Kampala, Uganda, as the new framework replacing the Malabo Declaration for agricultural transformation in Africa.

Key Points:

- **Policy Framework:** Guides Africa's agricultural and food systems transformation from 2026 to 2035.
- **Shift in Approach:** Moves beyond agriculture-led growth to a comprehensive **agri-food systems** approach, focusing on resilience and sustainability.
- **Goals:**
  - Combat climate change impacts on agriculture.
  - Address food insecurity and malnutrition.
  - Promote sustainable and resilient food systems.
- **Alignment:** Supports AU's **Agenda 2063** vision "The Africa We Want" and Africa's Common Position on Food Systems.

Background & Evolution:

- **2003 Maputo Declaration:** Called for 10% of national budgets to be allocated to agriculture and 6% annual productivity growth.
- **2014 Malabo Declaration:** Set targets on hunger eradication, trade expansion within Africa, resilience, and accountability.
- **2024 Review:** Revealed Africa is off-track in achieving Malabo targets; hunger still affects 20.4% of the population.

Model UPSC Mains Question:

Q **"The Kampala Declaration marks a strategic shift in Africa's agricultural policy from an agriculture-led growth model to a broader agri-food systems approach. Discuss the significance of this transition in addressing food security and climate resilience in Africa. What lessons can India draw from Africa's experience for its own agricultural sustainability?"**

Cryo-Born Baby Corals and Their Significance in Marine Conservation

Context:

Recently, the world witnessed a significant breakthrough in marine conservation with the successful transplantation of the first cryo-preserved baby corals onto the Great Barrier Reef. This innovation offers new hope for restoring and preserving fragile coral ecosystems threatened by climate change and human activities.

What is Coral Cryopreservation?

Coral cryopreservation is the process of freezing coral cells and tissues at ultra-low temperatures (around -196°C) to halt all biological activity and preserve genetic material indefinitely. This technique involves:

- Collecting coral reproductive material during spawning events when corals release sperm and egg bundles.
- Separating the sperm and freezing them in liquid nitrogen.
- Using cryoprotectants to prevent ice crystal formation that can damage delicate coral cells.
- Storing these samples in bio secure seed banks for future reef restoration efforts.

Importance of Cryo-Born Baby Corals:

- **Genetic Diversity Preservation:** Cryopreservation safeguards coral genetic material, ensuring the survival of diverse species even as reefs face bleaching and degradation.
- **Restoration Potential:** Frozen coral sperm can be thawed and used to fertilize eggs in controlled settings, producing baby corals that can be transplanted to damaged reefs, aiding regeneration.
- **Climate Resilience:** This technology supports the recovery of coral ecosystems impacted by rising ocean temperatures, acidification, and pollution.
- **Global Conservation Tool:** It complements traditional reef protection efforts and acts as an insurance policy against irreversible loss.

Coral Reefs – Ecological and Economic Significance:

- Corals are marine invertebrates that form extensive reefs through colonies of polyps, which secrete calcium carbonate skeletons.
- Reefs thrive in warm, shallow waters (16–32°C) primarily between 30°N and 30°S latitudes and support rich biodiversity.

- Coral reefs provide vital ecosystem services including coastal protection, habitat for marine life, fisheries, and tourism revenue.
- Threats include climate change-induced bleaching, ocean acidification, overfishing, and pollution.

Challenges and the Way Forward:

- **Technical Complexity:** Cryopreservation requires precise conditions to prevent cellular damage, necessitating advanced technology and expertise.
- **Scaling Restoration:** Transplanting cryo-born corals on a large scale is resource-intensive and requires sustained effort.
- **Integrated Conservation:** Cryopreservation must be combined with broader strategies like reducing carbon emissions, regulating fishing, and controlling pollution.
- **Policy and Funding:** Governments and international bodies need to support marine biotechnology research and deploy conservation funding effectively.

Model UPSC Mains Question:

Q **"Cryopreservation of coral sperm and transplantation of cryo-born baby corals represent a breakthrough in marine conservation. Discuss the significance of this technology in addressing the challenges faced by coral reefs. What are the major threats to coral ecosystems, and how can such scientific interventions be integrated with broader conservation strategies?"**

New Ramsar Sites

Background:

Wetlands are among the world's most productive ecosystems, providing vital services like water purification, groundwater recharge, flood control, and biodiversity conservation. The **Ramsar Convention**, signed in 1971, is an international treaty aimed at the conservation and sustainable use of wetlands.

India is a party to the Ramsar Convention and has been proactive in identifying and protecting its ecologically important wetlands. In 2024, India added **four new wetlands** to its Ramsar list, bringing the total number of Ramsar sites in the country to **89**.

These additions coincide with **World Wetlands Day (February 2)** and reinforce India's commitment to the **"wise use" of wetlands** as per Ramsar guidelines.

Explanation: New Ramsar Sites and Their Significance

1. **Therthangal Bird Sanctuary, Tamil Nadu**
    - Along the **Central Asian Flyway**; key site for migratory birds.
    - Hosts species like Spot-billed Pelican, Oriental Darter.
    - Recognized for its role in avian conservation.
2. **Sakkarakottai Bird Sanctuary, Tamil Nadu**
    - An **irrigation tank** that doubles as bird habitat.
    - Home to more than 40 bird species; recharged by the northeast monsoon.
    - Promotes wetland-agriculture linkage.
3. **Khecheopalri Wetland, Sikkim**
    - A **high-altitude sacred lake**, deeply revered by Buddhists and Hindus.
    - Cultural and spiritual significance, along with ecological value.
    - Reflects the convergence of faith-based conservation and biodiversity.
4. **Udhwa Lake, Jharkhand**
    - Comprises two jheels linked to the **Ganga River system**.
    - Rich in bird diversity and essential for water conservation in the region.
    - Located in the biodiversity-rich **Rajmahal Hills**.

Challenges Faced by Wetlands in India:

- Encroachment and urban expansion
- Agricultural runoff and pesticide pollution
- Invasive species and habitat degradation
- Fragmentation of migratory bird corridors
- Lack of community participation and traditional knowledge systems
- Weak enforcement of wetland rules

Way Forward: Strengthening Wetland Conservation

- **Effective Implementation** of the Wetlands (Conservation and Management) Rules, 2017
- Promote **community-based wetland management** involving local stakeholders
- Integration of **wetlands into climate resilience and disaster management planning**

- Leverage **traditional knowledge systems**, especially in sacred or culturally important wetlands
- Strengthen **scientific monitoring**, biodiversity documentation, and eco-tourism in a sustainable way
- Use **Ramsar recognition** as a tool to channel national and international funding and awareness

Model UPSC Mains Question:

Q **"The recent inclusion of four new wetlands under the Ramsar Convention underscores India's commitment to wetland conservation. Discuss the ecological and cultural significance of these newly recognized Ramsar sites. Also examine the key threats to Indian wetlands and suggest a strategy for their sustainable management."**