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Weekly Current Affairs

To The Point

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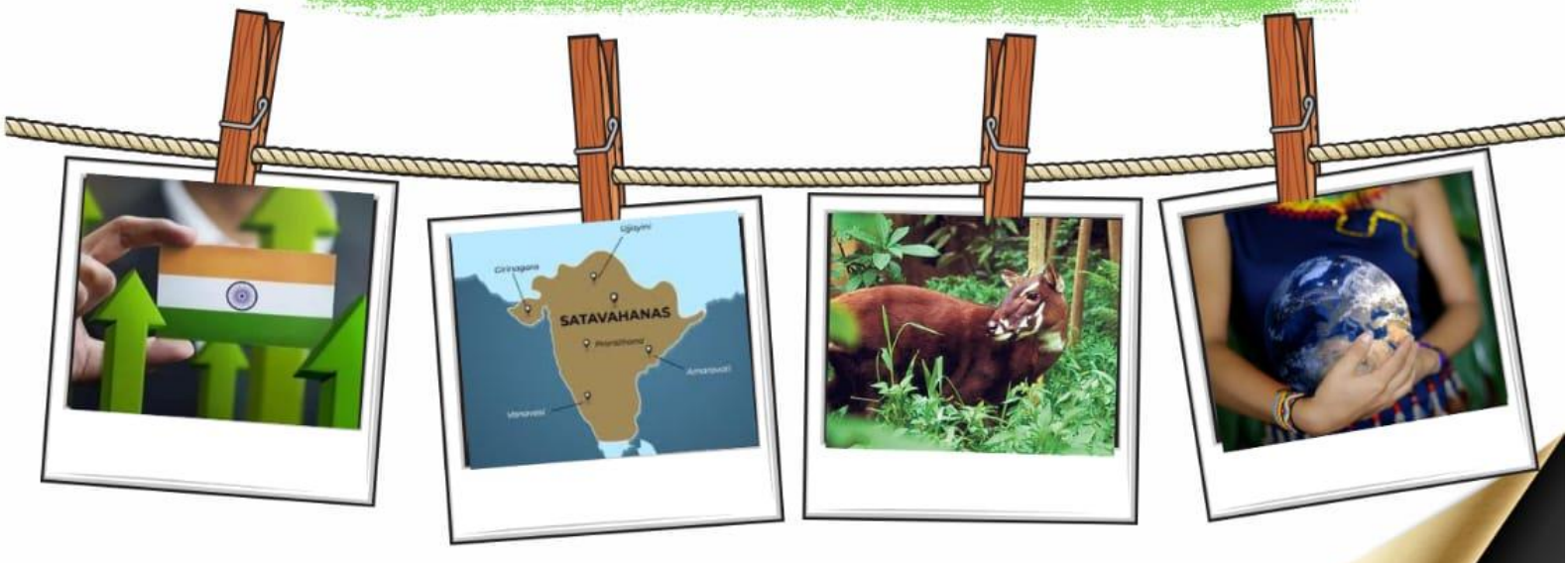

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GS Paper 1 – Indian Geography

Jenu Kuruba Tribe: Keepers of the Forest and Tradition

Context: In a significant moment for indigenous rights, **Jenu Kuruba families** have begun returning to their **ancestral forest lands** inside **Nagarhole National Park**, marking a powerful step toward reclaiming their cultural and ecological heritage.

Who are the Jenu Kuruba?

The **Jenu Kuruba tribe** is one of India's **Particularly Vulnerable Tribal Groups (PVTGs)**, residing primarily in the **Kodagu and Mysore districts** of **Karnataka**. Their name comes from the Kannada words **"Jenu" meaning honey** and **"Kuruba" referring to a community**, highlighting their traditional role as **honey gatherers and forest foragers**.

Livelihood and Cultural Identity:

For generations, the Jenu Kurubas have lived in harmony with the forest, drawing sustenance from **non-timber forest produce**, honey collection, small-scale **shifting agriculture**, and **minor forest-based crafts**.

- They live in small forest hamlets known as **"Hadi"**.
- Many also engage in wage labour or small-scale farming outside the forest during non-harvest seasons.

In different regions, they are also known as **"Then Kurumba"** or **"Kattu Naikar"**, reflecting variations in language and local naming traditions.

Social Structure and Leadership:

The **Jenu Kuruba community** follows a **semi-nomadic lifestyle** with a distinct social framework:

- Leadership is decentralized and traditional, led by a **headman (Yajamana)** and a **ritual leader (Gudda)**.
- These leaders manage internal disputes, community affairs, and rituals without interference from **formal law enforcement or religious institutions**.

Their system fosters **self-governance, mutual cooperation, and cultural continuity**, resisting homogenization under dominant societal norms.

Spiritual Beliefs and Expressions:

The tribe's **belief system** centers around **nature and ancestral spirits**. They have **unique deities** and **ritual practices** rooted in the forest ecosystem.

- Their **folk songs and dances** reflect themes of **marriage, farming, mythology**, and **seasonal rituals**.
- These cultural expressions are not only forms of entertainment but also means of preserving **oral history** and **spiritual wisdom**.

Struggles and Reclamation:

In recent decades, the Jenu Kurubas faced **displacement** due to wildlife conservation policies, particularly the creation of **Nagarhole National Park**. Despite their **sustainable relationship with the forest**, they were evicted in the name of ecological protection.

However, their return today is a result of **long-standing advocacy and legal support** under the **Forest Rights Act, 2006**, which recognizes the **rights of forest-dwelling communities** to reside and thrive in their ancestral habitats.

Did You Know?

- **PVTGs**, like the Jenu Kurubas, represent **the most marginalized tribal communities** in India, with low literacy rates, health indicators, and economic opportunities.
- The **Jenu Kuruba community** has often collaborated with **conservationists** to demonstrate how **indigenous stewardship of forests** can support biodiversity rather than harm it.
- **Nagarhole Forest**, their homeland, is a critical habitat for tigers, elephants, and many endemic species—underscoring the importance of **coexistence between conservation and indigenous rights**.

Conclusion: A Culture Rooted in the Forest

The story of the **Jenu Kuruba tribe** is one of **resilience, deep ecological knowledge**, and **cultural richness**. As they return to their rightful homes, they not only reclaim their land but also reinforce the idea that **indigenous communities are natural custodians of forests**, not threats to them. Their journey serves as a reminder that **development and conservation must always honor the voices of those who have lived in balance with nature for centuries**.

GS Paper 3 – Science & Technology

HAROP Drones: Precision Loitering Munitions in Modern Warfare

Context: In a powerful demonstration of advanced strike capability, the **Indian armed forces** recently utilized **Israeli-origin HAROP drones** during **'Operation Sindoor'** to target **critical air defence infrastructure** across Pakistan and Pakistan-occupied Kashmir (PoK).

What is the HAROP Drone?

The **HAROP (Harpy 2)** is a **loitering munition system**—a hybrid between a drone and a missile—**developed by Israel Aerospace Industries (IAI)**. Unlike conventional drones that return after completing surveillance tasks, HAROP is **designed to identify and destroy enemy targets** by crashing into them with its onboard explosive payload.

Dual Role: Surveillance and Strike

This drone belongs to a unique class of **autonomous kamikaze drones**. It can:

- **Loiter over a target area for several hours**
- **Detect radar signals or visual cues**
- **Dive onto the target with precision and eliminate it**

The **HAROP** is especially effective against **air defence systems, radar installations, missile batteries**, and **command-and-control centres**, offering the ability to suppress enemy air defences before a manned strike.

Key Features of HAROP:

- **Endurance**: Can **stay airborne for over six hours**, providing persistent surveillance and target-hunting capabilities.
- **Explosive Payload**: Carries a **16 kg high-explosive warhead**, capable of eliminating hardened targets.
- **Range & Speed**: Operational range of **200 km** and a **top speed of 417 km/h**.
- **Dimensions**: Wingspan of **3 meters**, length of **2.5 meters**.
- **Altitude**: Can operate at a **service ceiling of ~15,000 feet**.
- **Accuracy**: Delivers a **Circular Error Probable (CEP) of less than one meter**, ensuring pinpoint strikes.
- **Seeker Systems**: Equipped with **electro-optical (EO)** and **infrared (IR)** sensors to detect, track, and engage targets—even in **low-visibility conditions**.

Advanced Operational Capabilities:

- **Man-in-the-loop Mode**: Offers real-time human intervention for **precision strike decisions**, ensuring **ethical and tactical control**.
- **Abort Function**: Operators can **cancel a mission mid-flight** to prevent unintended collateral damage.

- **Stealth and Flexibility**: Launches from mobile ground stations and attacks from **steep or shallow angles**, bypassing terrain and radar-based defences.
- **Jamming Resistance**: Operates effectively in **GPS-denied environments**, offering **anti-jamming capabilities** critical for modern electronic warfare.

India and HAROP:

- India has been an **active user of HAROP drones for over a decade**, integrating them into its **tri-service strategic operations**. The drones have played a **key role in tactical surveillance and suppression of enemy air defences (SEAD)** during cross-border operations.

In recent years, India has considered upgrading its HAROP fleet with improved **target recognition**, **AI-based guidance**, and **enhanced range**, showcasing a continued commitment to **next-gen precision warfare systems**.

Did You Know?

- HAROP is based on IAI's earlier "**Harpy**" drone but includes **day/night surveillance and visual targeting**.
- It has been used by countries like **Israel, Azerbaijan, South Korea**, and **Germany** in **various combat theatres**.
- Its **"fire-and-forget" capability** combined with **real-time human oversight** makes it one of the most reliable loitering munitions in the world.

Conclusion: Drones That Think and Strike

The **HAROP drone** represents a **leap forward in precision strike technology**, blending **endurance, autonomy, and surgical accuracy**. As conflicts evolve into **high-tech hybrid warfare**, such systems will play an increasingly vital role in **counter-air defence**, **pre-emptive strikes**, and **deep-penetration missions**—offering nations like India a significant tactical edge on the battlefield.

GS Paper 3 – Economy

India Unveils Draft Climate Finance Taxonomy to Accelerate Green Investments

Context: India has taken a significant step toward aligning its climate goals with financial policy by introducing a **Draft Climate Finance Taxonomy**, aimed at attracting sustainable investments and strengthening the nation's transition to a low-carbon economy.

What is the Climate Finance Taxonomy?

The **Ministry of Finance** has released a draft framework titled **'India's Climate Finance Taxonomy'**, which aims to:

- **Define and classify economic activities** based on their environmental impact.
- **Steer capital flows** toward **clean energy and climate-resilient infrastructure**.
- **Prevent greenwashing**—the misleading promotion of projects as 'green' without meaningful environmental benefits.

This taxonomy is designed to support India's dual national targets:

- **Achieving Net Zero carbon emissions by 2070**
- **Transforming into a developed nation under the 'Viksit Bharat 2047' vision**

Key Objectives of the Framework:

The draft taxonomy serves as a **strategic tool for investors, financial institutions, and policymakers** by offering:

- **Clear definitions of climate-aligned investments**
- **Transparent criteria for project evaluation**
- **Support for low-carbon technologies and emission-reduction pathways**

It also acts as a **credible national benchmark** to counter inflated claims by developed countries in international climate finance negotiations, ensuring **greater accountability and transparency**.

Core Principles and Categories:

The taxonomy is built on **international best practices** while being tailored to India's development context. It classifies activities into two broad categories:

- **Climate Supportive**: Directly contribute to **greenhouse gas (GHG) reduction** or **climate resilience**. *Examples: Solar energy, electric mobility, energy-efficient buildings.*
- **Climate Transition**: Help reduce the **carbon intensity** of traditionally high-emission sectors. *Examples: Cleaner technologies in steel, cement, and thermal power.*

Key Sectors Identified for Green Investment:

The taxonomy highlights sectors critical for India's climate goals:

- **Power generation and distribution**
- **Green buildings and resilient infrastructure**
- **Low-emission transport and mobility**
- **Sustainable agriculture and food systems**

- **Water resource management and water security**

These focus areas will guide both **public and private investment** towards long-term environmental and economic sustainability.

Massive Push in Energy and Adaptation Investment:

Power Sector Expansion Goals:

India plans to dramatically scale up its **installed power generation capacity** from **470.4 GW (as of February 2025)** to **777.14 GW by 2049**.

A key focus will be on **Advanced Ultra Super Critical (AUSC) thermal power technology**, which offers:

- **Efficiency of 46%** (compared to ~38% for subcritical and ~41–42% for supercritical systems)
- **Lower carbon emissions** per unit of electricity generated

This represents a **transitional path** for coal-based power generation, enabling energy security while aligning with climate goals.

India's Climate Adaptation Investment Needs:

India's **Initial Adaptation Communication** to the United Nations (submitted in December 2023) estimates that the country needs a **whopping 56.68 trillion (≈ USD 648.5 billion)** by 2030 to fund adaptation measures.

The investment is required across several climate-vulnerable sectors, including:

- **Agriculture and food systems**
- **Forestry and biodiversity**
- **Fisheries**
- **Urban and rural infrastructure**
- **Water resources**
- **Ecosystem restoration and climate resilience**

This financial requirement underscores the **magnitude of climate risk** India faces and the **urgent need for resource mobilization**, both domestically and internationally.

Why This Matters Globally:

India's taxonomy initiative could serve as a **template for other developing economies**, helping them attract **climate finance** while resisting the practice of **greenwashing** by wealthier nations. It also reinforces India's role as a **responsible stakeholder** in global climate governance.

Did You Know?

- The European Union's **Sustainable Finance Taxonomy** served as one of the inspirations for India's framework.
- India is among a handful of developing countries creating a **national-level green finance classification system**.

Conclusion: A New Era for Climate-Aligned Capital

India's **Draft Climate Finance Taxonomy** marks a crucial turning point in the integration of **climate goals with economic planning**. By defining what truly qualifies as "green" or "transitional," this framework paves the way for **targeted investment**, **policy coherence**, and **global credibility**.

GS Paper 1 – Geography

Iran in the Spotlight: Celebrating 75 Years of Diplomatic Ties with India

Context: As part of commemorating **75 years of diplomatic relations**, **Iran's Foreign Minister** is on a significant visit to **India**, reinforcing the longstanding cultural, economic, and strategic partnership between the two nations.

Where is Iran Located?

Iran, officially known as the **Islamic Republic of Iran**, lies at the **strategic crossroads of West Asia**, acting as a vital geopolitical bridge between the **Middle East**, **Central Asia**, and **South Asia**.

- **Capital**: **Tehran**, a vibrant metropolis and Iran's political, cultural, and economic center.
- **Neighbouring Countries**:
  - **North**: Armenia, Azerbaijan, Turkmenistan
  - **East**: Afghanistan and Pakistan
  - **West**: Iraq
  - **Northwest**: Türkiye
- **Maritime Neighbours**: Bahrain, Kuwait, Oman, Qatar, and Saudi Arabia.

Surrounding Water Bodies:

Iran is uniquely flanked by key bodies of water:

- **North**: **Caspian Sea**, the world's largest inland water body by surface area.
- **South**: **Persian Gulf** and **Gulf of Oman**, crucial for global oil shipping lanes and naval strategy.

Geographical and Climatic Diversity

Iran's landscape is incredibly diverse, shaping its culture, agriculture, and settlement patterns.

- **Climate**: Varies from **arid deserts** to **semi-arid steppes**, with **subtropical** zones along the Caspian coast.
- **Mountain Ranges**:
  - **Zagros Mountains** (west) form a natural barrier and host oil reserves.
  - **Alborz Mountains** (north) contain **Mount Damavand** – Iran's **highest peak** at 5,610 meters and the **tallest volcano in Asia**.
- **Major Rivers**:
  - **Karun River** – Iran's only navigable river, vital for inland trade.
  - Others include **Dez**, **Karkheh**, and **Diyala**.

Rich Natural Resources:

Iran is renowned for its wealth of **natural resources**, which fuel its economy and geostrategic influence.

- **Hydrocarbons**:
  - One of the **top five nations** globally in terms of **proven oil and natural gas reserves**.

- **Minerals**:
    - Rich in **chromium**, **copper**, **iron ore**, **lead**, **manganese**, **zinc**, **sulphur**, and **coal**.
- Iran's **mining industry** is considered one of the **most underexplored** yet promising sectors in the region.

Interesting Facts About Iran:

- **Persian Civilization**: Iran is home to **one of the world's oldest continuous major civilizations**, dating back to **circa 7000 BCE**.
- **Cultural Heritage**: Cities like **Isfahan**, **Shiraz**, and **Persepolis** reflect the country's glorious imperial past and architectural marvels.
- **Language**: The official language is **Persian (Farsi)**.
- **Strategic Importance**: Iran sits on the **Strait of Hormuz**, a chokepoint through which nearly **one-fifth of the world's oil trade** passes.

India–Iran Relations: A Historical Connection

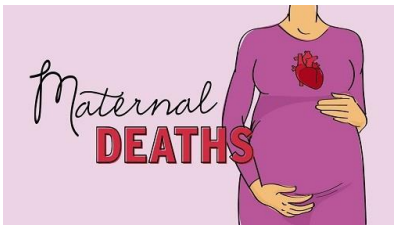
India and Iran share deep-rooted **historical, cultural, and linguistic ties**, strengthened by:

- **Shared interests in regional connectivity**, especially through the **Chabahar Port project**.
- Cooperation in **energy, infrastructure, and trade**.
- Common concerns about **regional security**, especially in **Afghanistan** and **West Asia**.

Iran's role as a regional powerhouse—rich in history, resources, and strategic value—makes it a critical partner for India in shaping a secure and prosperous neighbourhood.

GS Paper 2 – Governance, Health, and Social Justice

India Sees Remarkable Drop in Maternal Mortality: A Leap Towards Safer Motherhood



Context: India has taken a **significant step forward in maternal healthcare**, as reflected in the latest decline in the **Maternal Mortality Ratio (MMR)**. The country's MMR has reduced to **93 per 100,000 live births** during **2019–21**, compared to **97 in 2018–20** and **103 in 2017–19**, according to data from the **Office of the Registrar General and Census Commissioner of India**. This progress showcases the impact of targeted health policies, greater institutional support, and community-level awareness programs.

What is the Maternal Mortality Ratio (MMR)?

- The **Maternal Mortality Ratio** is a key measure of a nation's **maternal health and healthcare quality**. It represents the number of **maternal deaths per 100,000 live births** within a defined period. A **maternal death** refers to the **death of a woman during pregnancy or within 42 days** of the end of pregnancy, due to complications related to or worsened by the pregnancy itself, as defined by the **World Health Organization (WHO)**.

Global Benchmark: The **United Nations Sustainable Development Goal (SDG) 3.1** targets an MMR of **below 70 by 2030**. India's current decline marks a **positive trajectory** toward this global target.

Improving Trends but Uneven Progress Across States:

Despite national-level success, **regional inequalities** continue to pose a challenge. Several states are still recording **alarmingly high MMRs**, including:

- **Madhya Pradesh**: 175
- **Assam**: 167
- **Uttar Pradesh**: 151
- **Odisha**: 135
- **Chhattisgarh**: 132
- **West Bengal**: 109
- **Haryana**: 106

Demographic Highlight: The **20–29 years age group** accounts for the **highest number of maternal deaths**, followed by the **30–34 years group**—the most active reproductive age bracket. This signals an urgent need for **targeted maternal health interventions** for young women.

Key Causes Behind Maternal Mortality in India:

Maternal deaths are largely preventable. However, they continue due to a mix of **healthcare system gaps** and **social challenges**:

- **Obstetric complications** during pregnancy and childbirth
- **Unsafe abortions** due to lack of access to proper facilities
- **Delayed medical care** and lack of skilled attendants
- **Inadequate nutrition**, especially in rural and tribal areas
- **Social stigma** and low awareness around reproductive health

Global Context: Around **700 women die daily** from pregnancy-related complications worldwide, with over **90% of maternal deaths** occurring in **low- and lower-middle-income countries**—India included.

Government Programs Making a Difference:

India's drop in MMR is driven by the success of **key national health missions** and **maternal welfare programs**, including:

- **Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA)**: Offers **free quality antenatal checkups** on a fixed day every month.
- **Janani Suraksha Yojana (JSY)**: Provides **financial incentives** to encourage **institutional deliveries**, especially among underprivileged groups.
- **Ayushman Bharat Health and Wellness Centres**: Deliver **comprehensive primary healthcare**, including maternal and neonatal services.
- **POSHAN Abhiyaan**: Focuses on **nutritional enhancement** for mothers and children, especially in high-risk districts.

These programs have boosted **institutional birth rates**, enhanced **access to trained medical staff**, and supported **nutritional care** for expectant mothers.

Persistent Challenges That Need Urgent Focus:

While progress is evident, the journey toward maternal safety for all Indian women still faces critical roadblocks:

- **Poor infrastructure** in remote and economically backward regions
- **Lack of emergency obstetric care** in rural healthcare centers
- **Limited community outreach** and awareness of government programs
- **Cultural barriers** and **early marriages** increasing pregnancy-related risks

Special Concern: Teenage pregnancies, often due to early marriage, remain a **hidden contributor** to maternal deaths. Strengthening laws and awareness around **reproductive rights** is crucial.

Conclusion: Toward Safer Motherhood for Every Woman

India's consistent improvement in the **Maternal Mortality Ratio** is a testament to **robust policy execution**, growing **health infrastructure**, and **empowered communities**. However, achieving the **SDG target of MMR < 70** by 2030 will demand **sustained efforts**, especially in high-burden states.

Future efforts must emphasize:

- **Bridging rural-urban healthcare gaps**
- **Strengthening emergency care systems**
- **Boosting awareness on maternal entitlements and services**

With the right investments, India can ensure that **no woman dies while giving life**.

Guardians of Nature: The Vital Role of Indigenous Communities in Biodiversity Conservation

Context: Across the globe, **conservation models** often fail to recognize the crucial contributions of **Indigenous Peoples and Local Communities (IPLCs)**. While India took a progressive step with the **Forest Rights Act (FRA), 2006**, the dominant conservation paradigm still tends to be **state-centric**, frequently sidelining the traditional custodians of forests and biodiversity.

To truly achieve **sustainable and inclusive conservation**, India must empower IPLCs not only through legal recognition but also through active participation in environmental governance.

How Do Indigenous Communities Protect Biodiversity?

India is home to over **700 tribal communities**, each with deep ecological knowledge and cultural practices that are closely intertwined with the natural world. Their role in biodiversity conservation is both **practical and spiritual**, rooted in centuries-old traditions.

Preservers of Traditional Ecological Knowledge (TEK):

- IPLCs possess **rich oral knowledge** on medicinal plants, forest ecosystems, and animal behavior. **Example**: The **Kani tribe** of Kerala contributed to the discovery of the medicinal plant *Arogyapacha*, leading to the development of a patented drug and a benefit-sharing model.

Protectors of Sacred Forests and Community Lands:

- Tribal communities often maintain **sacred groves**, which serve as biodiversity hotspots. **Example**: The **Bishnoi community** of Rajasthan protects **Khejri trees**, antelopes, and birds, often risking their lives for wildlife.

Custodians of Native Crops and Seeds:

- Indigenous farming methods help maintain **genetic diversity** in agriculture. **Example**: In Odisha and Nagaland, communities practice **jhum cultivation** with long fallow periods, preserving **indigenous seed varieties** and soil fertility.

Living in Harmony with Wildlife:

- Cultural taboos and ethical codes promote **non-exploitative interactions** with nature. **Example**: The **Soliga tribe** of Karnataka coexists with tigers and elephants in the **Biligiri Rangaswamy Temple (BRT) Tiger Reserve**, demonstrating **peaceful cohabitation**.

What Legal Frameworks Support Indigenous Conservation in India?

India has introduced several progressive laws and policies aimed at recognizing the ecological role of IPLCs:

Biological Diversity Act (BDA), 2002:

- Establishes **Biodiversity Management Committees (BMCs)** at local levels to record and conserve biodiversity, and safeguard **traditional knowledge**.

Forest Rights Act (FRA), 2006:

- Grants **legal rights to forest land and resources** to Scheduled Tribes and other traditional forest dwellers.

- Empowers **Gram Sabhas** to manage and conserve forests, ensuring community-led sustainable practices.

Panchayats (Extension to Scheduled Areas) Act (PESA), 1996:

- Gives **tribal communities control over land and water resources** in Scheduled Areas, promoting **decentralized natural resource management**.

Joint Forest Management (JFM):

- Encourages **collaborative forest governance** between forest departments and local communities, especially in **non-timber forest product (NTFP)** management.

National Biodiversity Action Plan (NBAP):

- Supports **participatory conservation**, integration of **traditional practices**, and community capacity-building to enhance **ecosystem resilience**.

What More Can Be Done to Empower IPLCs in Conservation?

While India's legal framework is commendable, **implementation gaps** and **top-down approaches** persist. To foster a more inclusive model of conservation:

1. **Fully Enforce the Forest Rights Act (FRA):**
   - Expedite **Community Forest Resource (CFR)** claims.
   - Strengthen the decision-making role of **Gram Sabhas** in conservation areas.
   - Train local leaders in biodiversity governance.
2. **Integrate Indigenous Knowledge in Policy Making:**
   - Establish national and state-level platforms to **document traditional knowledge**.
   - Involve IPLCs in drafting **local biodiversity plans** and forest management strategies.
3. **Include IPLCs in the '30 by 30' Global Biodiversity Agenda:** India's commitment to protect **30% of its land and marine ecosystems by 2030** must **include IPLCs as co-managers**, not just beneficiaries.
4. **Promote Ethical Use of Traditional Knowledge:** Prevent **biopiracy** by ensuring **intellectual property rights** and **benefit-sharing mechanisms** with local communities.
5. **Strengthen Biodiversity Management Committees (BMCs):** Provide legal backing, training, and funding to **enable BMCs to actively participate** in ecological decision-making.
6. **Provide Financial Incentives for Community Conservation:**
   - Introduce **eco-certification**, **carbon credit systems**, and **community forest enterprise grants**.
   - Support local innovations such as **eco-tourism**, **wildlife stewardship**, and **sustainable harvesting** of forest products.

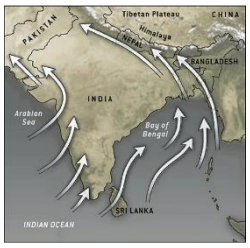
Conclusion: Indigenous Wisdom, the Key to India's Ecological Future

India's indigenous communities are **not just stakeholders—they are stewards** of the nation's biodiversity. Their **deep ecological insights**, **communal ethics**, and **nature-based traditions** offer time-tested solutions to environmental degradation.

By ensuring **legal recognition**, **financial empowerment**, and **decision-making authority**, India can create a truly **inclusive conservation model**—one that honors both **ecological sustainability** and **social justice**.

GS Paper 1 – Indian Geography

Early Arrival of Indian Monsoon: IMD Signals Possible Advancement in 2025



Context: The **India Meteorological Department (IMD)** has recently hinted at a **potential early onset** of the **southwest monsoon**, which typically begins over **Kerala around June 1**. Normally, it takes about **10 days** for the monsoon winds to progress from the **Nicobar Islands** to the southern tip of the Indian mainland. This early onset could have significant implications for **agriculture**, **water management**, and **disaster preparedness**.

Understanding the Indian Monsoon: Natural Engine of South Asia

- The **Indian monsoon system** is one of the most **complex and powerful weather phenomena** in the world, driven by multiple interacting climatic forces. Here's a breakdown of the key **mechanisms** that generate and sustain the monsoon:

1. **Land–Sea Thermal Contrast**: During summer, the **Indian subcontinent heats up more rapidly** than the surrounding ocean. This creates a **low-pressure zone over land**, drawing in **moist, cool air** from the ocean, which rises and forms **rain-bearing clouds**.
2. **Inter-Tropical Convergence Zone (ITCZ):** The **ITCZ**—a low-pressure belt near the **equator—shifts northward** during the summer. This **draws trade winds** towards the subcontinent, feeding the monsoon system and enhancing rainfall, especially over the **Indo-Gangetic plains**.
3. **Tibetan Plateau's Role:** The **elevated Tibetan Plateau** becomes intensely heated, forming a **thermal low** that strengthens **vertical air circulation**, further **intensifying the inflow** of moist monsoon winds.
4. **Tropical Easterly Jet (TEJ):** This **high-altitude jet stream**, active during summer, **supports the monsoon trough**, enhancing both **rainfall intensity** and **geographical spread**.

Oceanic Influencers: ENSO & Indian Ocean Dipole (IOD)

El Niño–Southern Oscillation (ENSO):

- **El Niño:** Warms the **central Pacific Ocean**, typically **weakening the Indian monsoon**.
- **La Niña:** Cools Pacific waters and is often **linked with enhanced monsoon rainfall**.

Indian Ocean Dipole (IOD):

- **Positive IOD:** Warmer waters in the western Indian Ocean **boost monsoon rains**.
- **Negative IOD:** Leads to **drier conditions** and **weaker monsoons** over India.

Stages of the Monsoon: From Onset to Withdrawal

Arabian Sea Branch:

- Arrives over **Kerala by June 1**, moves up the **west coast**, soaking regions like **Goa, Maharashtra**, and the **Western Ghats**.

Bay of Bengal Branch:

- Hits **Northeast India** in early June, then spreads across the **Indo-Gangetic plains**. The entire country is generally covered by **mid-July**.

Monsoon Retreat:

- Begins from **northwestern India** in **October**. The shift in winds causes **"October Heat"**—hot, humid conditions after rainfall ceases.
- Brings **post-monsoon rains** to **southeastern India**, especially **Tamil Nadu and Andhra Pradesh**.

Monsoon's Impact: Lifeline of India:

Agriculture:

- Powers the **Kharif cropping season**, especially for **rice, maize**, and **pulses**.
- Over **50% of Indian farmland** is **rain-fed**, making monsoon performance **crucial for food security**.

Economy:

- Monsoon-driven agriculture affects **GDP**, **inflation**, **rural incomes**, and **employment**.

Water & Energy:

- Recharges **rivers, lakes, aquifers**, and **hydroelectric dams**, providing water for **drinking**, **irrigation**, and **electricity generation**.

Biodiversity & Culture:

- Sustains **forests**, **wetlands**, and **ecosystems**.
- Central to **cultural traditions**, **festivals**, and **folk practices** celebrating rain.

Disasters:

- **Excess rainfall** often causes **floods**, **landslides**, and **urban waterlogging**—especially in vulnerable, densely populated regions.

Scientific Progress: Strengthening Forecast Accuracy:

Monsoon Mission (2012):

- Launched by the **Ministry of Earth Sciences**, this mission focuses on **improving dynamical modeling** for better **medium and long-term monsoon forecasts**.

National Supercomputing Mission:

- Supports **high-performance computing** capabilities to run **complex weather models** for **more accurate monsoon predictions**.

IMD–ICAR Collaboration:

- Delivers **Agrometeorological Advisory Services** to farmers, offering **region-specific weather forecasts** and **farming advice** to boost **climate resilience** in agriculture.

Did You Know?

- The Indian monsoon **directly affects nearly 70% of India's population**, especially those involved in agriculture.
- A **"normal monsoon"** delivers **96% to 104%** of the **Long Period Average (LPA)** rainfall, currently pegged at **87 cm**.
- **2022 and 2023** saw erratic monsoon patterns due to **back-to-back La Niña and El Niño cycles**.

Looking Ahead:

An **early monsoon** in 2025 could bring **early sowing opportunities** for farmers but may also pose **risks of intense early flooding** or **pest outbreaks**. It underscores the importance of **scientific preparedness**, **policy responsiveness**, and **climate adaptation strategies** in an era of growing **weather unpredictability**.

GS Paper 2 – Governance and Polity

Sutlej-Yamuna Link (SYL) Canal Dispute: A Legal and Political Stalemate

Context: The long-standing **Sutlej-Yamuna Link (SYL) Canal dispute** has once again resurfaced, with the **Supreme Court strongly criticising Punjab** for its unilateral decision to de-notify land acquired for the canal's construction. The apex court termed the move an act of "**high-handedness**," reiterating its earlier directive to maintain **status quo** on the canal-related land and infrastructure.

What is the SYL Canal and Why is it Controversial?

The **SYL Canal**, proposed to facilitate the **equitable distribution of water** from the **Ravi and Beas rivers**, was intended to address water needs of the states of **Punjab, Haryana**, and **Rajasthan**.

- The planned length of the canal was **214 km**, with **122 km in Punjab** and **92 km in Haryana**.
- However, decades later, the project remains **incomplete** due to legal challenges, political opposition, and inter-state tension.

Timeline of the SYL Canal Dispute:

- **1981 Agreement**: A tripartite agreement between **Punjab, Haryana, and Rajasthan** laid the foundation for sharing Ravi-Beas waters and constructing the SYL canal.
- **1996**: Haryana filed a suit in the Supreme Court demanding Punjab complete its share of canal construction.
- **2002**: The Supreme Court ruled in **favour of Haryana**, directing Punjab to proceed with the canal.
- **2004**: Punjab passed the **Punjab Termination of Agreements Act**, aiming to annul all prior water-sharing agreements.
- **2016**: A **Constitution Bench** struck down the 2004 Act, declaring it **unconstitutional**.
- **2024–25**: Punjab's latest de-notification of SYL land has triggered fresh judicial scrutiny.

Recent Supreme Court Directions:

- The Supreme Court appointed the **Union Home Secretary**, **Chief Secretary of Punjab**, and **Punjab's DGP** as *Receivers* to manage land-related issues.
- The court stressed the need for **mutual consensus** among Punjab, Haryana, and the Centre.
- If unresolved, the matter will return to the bench on **August 13**.

Legal Framework for Inter-State Water Disputes in India:

Under **Article 262** of the **Indian Constitution**, Parliament is empowered to enact laws to **resolve inter-state river water disputes**, and once a tribunal is formed under this provision, **courts are barred** from intervening.

Key Legislations:

- **River Boards Act, 1956**: Allows the Centre to form river boards with states, though **no board has ever been created**.

- **Inter-State River Water Disputes Act, 1956 (ISRWD)**: Provides for formation of tribunals upon states' request; amended in **2002** to mandate:
    - **Tribunal formation within one year**
    - **Decision within five years**
    - **Awards carry the weight of a Supreme Court order**
    - **Clarification window of 3 months**

Persistent Issues with Tribunals:

- **Delays**: Disputes often drag on for decades. For instance, the **Cauvery Water Disputes Tribunal** took **17 years** (1990–2007).
- **Implementation Gaps**: States resist enforcement of tribunal awards.
- **Judicial Overlap**: Despite constitutional limits, states invoke **Article 136** and **Article 32** to challenge awards in the Supreme Court.
- **Lack of Technical Input**: Tribunals often lack **scientific expertise**, being dominated by judges.
- **Opaque Water Data**: States often **withhold or manipulate hydrological data**, impeding fair judgment.
- **Federal Complications**: **Bureaucratic overlaps** between state and central agencies slow the process.

Proposed Reforms for Speedy and Fair Dispute Resolution:

Inter-State River Water Disputes (Amendment) Bill, 2019:

- Proposes a **permanent tribunal** for all inter-state river disputes.
- Introduces a **Dispute Resolution Committee (DRC)** to promote **pre-tribunal negotiation**.
- Recommends inclusion of **hydrologists, ecologists, and engineers** as **technical members**.
- Suggests creation of an **independent water data authority** under the **Central Water Commission (CWC)**.

Emphasis on Alternative Dispute Resolution (ADR):

- Encourages **mediation and negotiation** by **neutral parties** or the **Union Government** as a means of amicable and faster settlement.

The Bigger Picture:

The SYL canal case is more than just a regional infrastructure issue—it embodies the **challenges of federalism, environmental stress, and political mistrust** in water governance. With **climate change** exacerbating water scarcity, resolving such disputes with **science-based, transparent, and time-bound mechanisms** is now more urgent than ever.

GS Paper 3 – Economy and Infrastructure

Revised SHAKTI Policy: Powering India's Energy Security with Transparent Coal Allocation

Context: The **Cabinet Committee on Economic Affairs (CCEA)** has approved a major revamp of the **SHAKTI Policy (Scheme for Harnessing and Allocating Koyala Transparently in India)**, aiming to streamline coal allocation and energize the power sector with improved transparency, accessibility, and efficiency.

SHAKTI Policy: A Shift Towards Transparent Coal Allocation

Launched in **2017**, the SHAKTI policy marked a pivotal transition from the earlier **nomination-based coal linkage system** to a more **transparent, auction and tariff-based** allocation mechanism. The latest **revision of the SHAKTI policy** brings in a host of **innovative features**, aiming to:

- **Broaden eligibility** for coal allocation
- Provide **greater flexibility** in the linkage mechanism
- Ensure **enhanced access to coal** for all power producers

These changes will lead to **increased power generation**, **lower electricity tariffs**, and a **boost to economic productivity** by ensuring a reliable supply of fuel to power plants.

India's Coal Sector: Backbone of the Power Industry

Coal continues to be the **cornerstone of India's energy mix**, playing a critical role in the nation's development.

- **Record Production**: India crossed the **1 billion tonne production mark** in FY 2024–25, registering a **4.99% annual growth**.
- **Global Ranking**: India is the **second-largest coal producer** and **consumer** in the world.
- **Reduced Import Dependency**: Coal imports fell by **8.4%**, saving foreign exchange and reducing vulnerability to global price fluctuations.
- **Dominant Energy Source**: Coal contributes nearly **55%** of India's energy supply and **powers over 74%** of electricity generation.

Key coal-producing regions include **Jharkhand, Odisha, West Bengal, Chhattisgarh**, and **Madhya Pradesh**.

Economic Importance of the Coal Sector:

- **Rail Freight**: Coal is the **largest freight commodity** for Indian Railways, contributing **49% of total freight revenue**.
- **Government Revenue**: The sector yields over **70,000 crore annually** through **royalties, GST, and levies**.
- **Employment Generator**: Employs over **239,000 workers** in **Coal India Ltd (CIL)** and thousands more through contractors and logistics networks.

Major Challenges in India's Coal Landscape:

Despite its dominance, India's coal sector grapples with several persistent issues:

- **Environmental Concerns**: High **carbon emissions**, **air pollution**, and **ecosystem degradation** from mining activities.

- **Import Dependency**: Continued need for **coking coal** and **high-grade thermal coal**, despite large domestic reserves.
- **Regulatory Delays**: Slow **land acquisition** and **environmental clearances** delay coal block development.
- **Underutilization**: Mining operations often run **below capacity** due to demand fluctuations and infrastructure issues.
- **Climate Commitments**: India's **Net Zero by 2070** goal puts pressure to phase down coal usage.
- **Limited Private Sector Role**: The sector is **dominated by PSUs**, limiting competition and innovation.

Government Initiatives to Modernize the Coal Sector:

To address these challenges, several forward-looking reforms have been introduced:

- **Commercial Coal Mining (2020)**: Allows **private players** to mine and sell coal without end-use restrictions—promoting **competition** and **self-sufficiency**.
- **Single Window Clearance Portal (2021)**: Speeds up approval processes for land, forest, and environment clearances.
- **Auction for Non-Regulated Sectors**: Coal blocks are auctioned for use in **steel, cement, aluminum**, etc., expanding the market.
- **Coal Gasification Target**: India plans to **gasify 100 million tonnes** of coal by **2030**, reducing pollution and diversifying coal usage.
- **Technology Upgrades**: **Drones, GPS tracking**, automated loading, and **online coal sale portals** increase transparency and safety.
- **Coal Logistics Modernization**: **Dedicated freight corridors** and **first-mile connectivity** projects improve coal transport efficiency.
- **Access for SMEs**: Through **e-auctions**, even small industries can procure coal at **market-linked prices**, enhancing inclusivity.

Conclusion: A Balanced Path Towards Energy Transition

While coal remains vital for India's **short- to mid-term energy security**, a **strategic and balanced transition** toward cleaner energy is imperative. The revised SHAKTI policy reflects the government's intent to **strengthen domestic production**, **enhance transparency**, and **support power affordability**. It aligns with the broader vision of **Viksit Bharat**—an energy-secure, self-reliant, and sustainable India.

GS Paper 3 – Science and Technology, Environment

Cloud Seeding in NCR: Delhi Launches High-Tech Battle Against Air Pollution

Context: In a bold move to combat severe air pollution, the **Delhi Cabinet has approved a 3.21 crore project** to conduct **five cloud-seeding trials** across the **National Capital Region (NCR)**. This decision marks a significant technological intervention aimed at improving air quality through **artificial rainfall generation**.

What is Cloud Seeding?

Cloud seeding is a **weather modification technique** designed to **enhance rainfall** by artificially stimulating precipitation. It works by dispersing substances into the atmosphere that encourage cloud droplets to coalesce and fall as rain.

How it Works:

- **Seeding agents** such as **silver iodide**, **potassium iodide**, **dry ice**, or **liquid propane** are dispersed using aircraft, rockets, or ground-based generators.
- These particles act as **condensation nuclei**, encouraging moisture in clouds to form droplets large enough to precipitate.
- The method is also used to **suppress hailstorms**, **reduce dust**, and **clear particulate matter**, improving **air quality**.

Ideal Conditions for Successful Cloud Seeding:

Cloud seeding **cannot create clouds**—it can only enhance precipitation from **existing cloud systems**. The effectiveness depends on several meteorological factors:

- **Cloud Type and Depth**: The cloud must be **sufficiently thick** and have the **right moisture content**.
- **Temperature Range**: Optimal conditions exist when cloud temperatures are between **-10°C and -12°C**, allowing the seeding agents to form ice crystals.
- **Wind Speed**: Wind must be **moderate** to prevent dispersal of the seeding material away from target areas.
- **Topography**: Hilly and mountainous regions are particularly suited for effective seeding due to better cloud formation and moisture dynamics.

Challenges and Concerns:

Despite its promise, cloud seeding comes with **scientific, environmental, and ethical concerns**:

- **Chemical Impact**: The use of agents like **silver iodide** may pose **risks to soil and water quality**, potentially affecting agriculture and drinking water sources.
- **Rain Redistribution**: Inducing rainfall in one area might inadvertently **reduce natural rainfall** in neighboring regions, leading to **localized droughts**.
- **High Operational Costs**: The technology requires **advanced aircraft, skilled meteorologists**, and **precise coordination**, making it a **resource-intensive process**.

Why Cloud Seeding for Delhi?

Delhi's air quality regularly plunges to **hazardous levels**, especially during winter months when **stubble burning, vehicle emissions**, and **low wind speeds** combine to create a toxic smog blanket. Cloud seeding offers a **temporary but immediate solution**:

- It can help **settle airborne pollutants** by encouraging rainfall.
- Provides **respite during critical pollution spikes** when other mitigation strategies fall short.

The Way Forward: Technology as Part of a Larger Solution

While cloud seeding may **offer short-term relief**, experts stress that it must not be seen as a standalone fix. A **multi-dimensional strategy** is essential, which includes:

- **Stringent emissions control**
- **Expansion of green spaces and urban forests**
- **Shift to cleaner fuels and public transport**
- **Health preparedness for pollution-related diseases**

Conclusion:

The Delhi government's decision to embrace **cloud seeding** is a landmark initiative, combining **science and governance** in the fight for breathable air. While not a silver bullet, it represents a bold step forward in **climate adaptation** and **urban pollution management**.

GS Paper 1,3 – Geography, Disaster Management

Anak Krakatau Volcano: Rising Fury of the 'Child of Krakatoa'

Context: Anak Krakatau, meaning "**Child of Krakatoa**," continues to remind the world of the volatile power lying beneath the Earth's crust. Recently, satellite radar analysis revealed that the **volcano's deadly 2018 collapse**—which triggered a destructive tsunami—was **preceded by years of unnoticed ground deformation**, highlighting the urgent need for enhanced monitoring of volcanic activity.

Where is Anak Krakatau Located?

- Nestled in the **Sunda Strait**, between **Java and Sumatra** in **Indonesia**, Anak Krakatau is part of the **volatile Pacific Ring of Fire**—a horseshoe-shaped zone known for its **frequent earthquakes and volcanic eruptions**. This region houses **more than 75% of the world's active and dormant volcanoes**.

Birth of a Volcano: From Krakatoa's Ashes

- Anak Krakatau **emerged from the sea in 1927**, following the **catastrophic eruption of Krakatoa in 1883**, one of the most violent eruptions in recorded history. That eruption produced an explosion **heard over 3,000 km away**, generated **tsunamis over 30 meters high**, and killed more than **36,000 people**.
- Rising from the submerged remnants of that disaster, Anak Krakatau began its own **stages of growth through frequent strombolian eruptions**—a volcanic activity pattern marked by **regular, explosive bursts of lava**.

Eruptions and Geological Activity:

- Since 1963, Anak Krakatau has **erupted at least nine times**, with most episodes **lasting less than a year**. It is built on **layered deposits of lava, ash, and volcanic rocks**, making it a **classic stratovolcano** with steep sides and powerful eruptions.

The **volcano sits atop multiple magma chambers**, creating a **complex and unstable system** that poses significant risks to nearby populations and coastlines.

The 2018 Collapse and Tsunami Tragedy:

- On **22 December 2018**, a violent eruption led to the **collapse of the volcano's southwestern flank**. The resulting **underwater landslide** displaced enough material to generate a **tsunami**, which struck the coasts of **southern Sumatra and western Java** with **little warning**, killing **over 430 people** and injuring thousands.

What makes this event even more tragic is the **satellite data revelation**: **slow deformation of the volcano's structure had been ongoing for years**, but it went largely unnoticed due to **lack of detailed monitoring**.

Scientific Advances and Monitoring Gaps:

- Recent studies using **Interferometric Synthetic Aperture Radar (InSAR)** have uncovered **pre-eruption ground movement**, proving that modern satellite tools can be instrumental in **forecasting potential disasters**.
- However, **Indonesia's archipelagic geography and limited resources** mean that many volcanoes are **under-monitored**, putting millions at risk.

Did You Know?

- Anak Krakatau **grows by several meters every year** due to regular eruptions.
- Indonesia has **more active volcanoes than any other country**, with **more than 120 volcanoes currently active**.

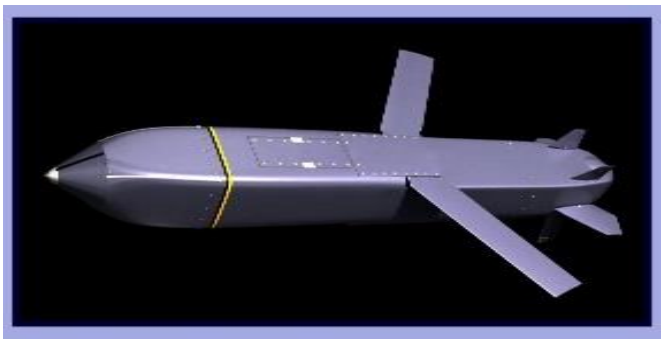
The region is part of the **collision zone between the Indo-Australian and Eurasian tectonic plates**, making it one of the **most tectonically active areas in the world**.

Conclusion: A Living Reminder of Earth's Power

Anak Krakatau is not just a geological marvel—it is a **living, growing reminder** of how dynamic and dangerous Earth's interior can be. While its eruptions offer valuable scientific insights, they also underscore the **need for robust early warning systems**, **international cooperation**, and **public awareness** to reduce future risks.

SCALP Missile: Precision Firepower from the Skies

Context: In a strategic show of strength during **Operation Sindoor**, **SCALP missiles** were reportedly deployed by **Indian Rafale fighter jets** to deliver precision strikes on **terror infrastructure** located deep within **Pakistan and Pakistan-occupied Kashmir (PoK)**. This marks a significant demonstration of India's long-range strike capability and reinforces its ability to conduct high-value operations with surgical accuracy.



What is the SCALP Missile?

Known internationally as **Storm Shadow**, the **SCALP missile** is a **long-range, air-launched cruise missile** specifically designed for **deep strike missions**. It is **conventionally armed** and targets **fixed or fortified installations**, such as command centers, bunkers, and strategic infrastructure.

The acronym **SCALP** stands for *Système de Croisière Autonome à Longue Portée*, or **Autonomous Long-Range Cruise System**, emphasizing its **autonomous targeting capability and extended operational reach**.

Origin and Global Use:

- **Jointly developed by France and the United Kingdom**, SCALP is a product of European defense collaboration under **MBDA Systems**.
- It is operational in the air forces of **India, UK, France, Egypt, Italy, Greece, Saudi Arabia, Qatar**, and the **United Arab Emirates (UAE)**.
- **India acquired SCALP as part of the Rafale fighter jet deal**, giving the Indian Air Force an advanced precision-strike capability over hostile territory.

Key Features of the SCALP Missile:

- **Range**: Capable of striking targets at a range of **approximately 500 km**, allowing **deep penetration into enemy territory** without endangering aircraft.
- **Warhead**: Carries a **450 kg BROACH warhead** (Bomb Royal Ordnance Augmented Charge), designed to **pierce hardened shelters and underground bunkers**.
- **Size & Weight**: The missile is **around 5 meters in length**, has a **3-meter wingspan**, and **weighs roughly 1,300 kg**.
- **Stealth & Navigation**: Flies at **low altitudes** using **terrain-following radar**, **INS/GPS navigation**, and **infrared terminal guidance**.
- **Precision Targeting**: In the terminal phase, the missile's **infrared seeker compares real-time images to pre-programmed target visuals**, ensuring **pinpoint accuracy with minimal collateral damage**.
- **Weather Independence**: Its sophisticated design enables **operation in all weather conditions, day or night**.

Launch Platforms and Indian Integration:

The SCALP missile has been **custom-integrated into India's Rafale fleet**, significantly expanding the Indian Air Force's strike envelope. It offers **strategic deterrence** and the ability to **neutralize high-value assets across difficult terrain**, including mountainous regions and fortified zones.

Did You Know?

- The SCALP has been **combat-tested in Iraq, Syria, and Libya**, where it demonstrated **high precision and reliability**.
- The missile is part of a new generation of stand-off weapons, allowing **jets to launch from a safe distance, outside enemy air defense range**.
- Its **stealthy profile and low radar cross-section** make it **hard to detect and intercept**, even in heavily contested airspace.

Conclusion: A Game-Changer in Modern Warfare

The **SCALP missile** represents a leap forward in **long-range precision warfare**, enhancing India's ability to **pre-empt or respond to cross-border threats with surgical precision**. Its integration into the **Rafale platform** reflects India's commitment to building a **technologically superior, responsive, and versatile air strike capability** for 21st-century warfare.

GS Paper 2 – Governance, Constitution, and Polity

Supreme Court Judges Publicly Declare Assets – A Milestone in Judicial Transparency

Context: In a landmark move toward **judicial accountability**, **21 sitting judges** of the **Supreme Court of India**, including the **Chief Justice of India (CJI)**, have voluntarily disclosed their **financial assets and liabilities** on the apex court's official website.

Background: Evolving Discourse on Judicial Ethics

- **Judicial accountability** has long been debated in India, especially regarding **financial transparency** and **ethical standards**.
- **Judges**, unlike legislators or civil servants, are **not legally required** to publicly declare their assets.
- The current disclosures stem from a **Full Court Resolution**, signaling a commitment to **public confidence** and **openness**.

Timeline of Key Developments:

Year	Event
1997	First **Full Court Resolution** under **CJI J.S. Verma** recommends judges disclose assets to the Chief Justice.
2009	A new Full Court resolution allows **voluntary disclosure** of assets on the Supreme Court website.
2009	The **Delhi High Court** rules that such declarations are "information" under **Section 2(f)** of the **RTI Act, 2005**.
2019	A **Constitution Bench** declares the **CJI a 'public authority'** under the **RTI Act**, supporting the public interest in asset disclosure.
2025	The **Supreme Court** begins **proactively publishing** judges' assets, including familial ties, on its website.

Significance of Asset Declaration:

- **Promotes Transparency**: Demonstrates a commitment to **ethical conduct** and **clean governance**.
- **Builds Public Trust**: Counters perceptions of **elitism**, **opacity**, or **bias** in the judiciary.
- **Upholds Constitutional Morality**: Reflects the values of **integrity**, **accountability**, and **responsibility** in line with the **Preamble** and **Directive Principles** (Part IV) of the Indian Constitution.

Why Judicial Integrity Matters:

Guardian of the Constitution:

- The judiciary safeguards **fundamental rights**, ensures **rule of law**, and maintains **institutional checks and balances**.

Ensuring Accountability:

- Lack of transparency may lead to **judicial corruption**, **delays**, or **misuse of authority**.

- Asset declarations help **deter conflicts of interest** and enhance **public scrutiny**.

Institutional Stability:

- In times of **political crisis** or **social unrest**, a **trustworthy judiciary** acts as a **pillar of democracy** and reinforces **national unity**.

Concluding Thoughts:

Transparency and ethical conduct are **not optional** in a democracy—they are the **lifeblood of judicial legitimacy**. The Supreme Court's move to disclose judges' assets is a **progressive step** toward a **more accountable, inclusive, and respected judiciary**.

A **strong and transparent judiciary** isn't just a constitutional ideal—it is a **moral imperative** for **democratic governance** and **societal harmony**.

GS Paper 3 – Economic Development

Human Development Report 2025 – UNDP Insights

Context: The **United Nations Development Programme (UNDP)** has released the **Human Development Report (HDR) 2025**, titled:

"A Matter of Choice: People and Possibilities in the Age of AI"

The report emphasizes how **Artificial Intelligence (AI)** is reshaping the future of **human development**, while highlighting India's progress in **health**, **education**, and **income**.

Human Development Index (HDI): Concept and Dimensions

Conceived by **Pakistani economist Mahbub ul Haq** in **1990**, HDI is a composite index used to measure a country's **socio-economic development** through:

1. Health:

- Measured by **Life Expectancy at Birth**
- Related to **SDG-3: Good Health and Well-being**

2. Education:

- Assessed by **Mean Years of Schooling** (SDG-4.4)
- And **Expected Years of Schooling** (SDG-4.3)

3. Standard of Living:

- Measured via **Gross National Income (GNI) per capita**
- Adjusted for inequality (SDG-8.5)

HDI Categories:

Development Level	HDI Value
Low Human Development	Below 0.550
Medium Human Development	0.550 – 0.699
High Human Development	0.700 – 0.799
Very High Development	0.800 and above

Limitations & Complementary Indices:

HDI doesn't account for **inequality**, **poverty**, **security**, or **empowerment**. To bridge these gaps, UNDP also uses:

1. **Inequality-adjusted HDI (IHDI)**
2. **Gender Inequality Index (GII)**
3. **Multidimensional Poverty Index (MPI)**

Global HDI Rankings (2023 Snapshot):

- **Top Ranked**: **Iceland (0.972)**, followed by **Norway** and **Switzerland**
- **Lowest**: **South Sudan** (Rank 193, HDI: 0.388)

India's HDI Performance:

- **HDI Rank**: **130th** (up from 133rd in 2022)
- **HDI Value**: **0.685** (from 0.676)
- India remains in the **Medium Human Development** category.

- **53% HDI growth** since 1990, **outpacing** global and South Asian averages.

Comparison with Neighbours:

Country	Rank
China	75th
Sri Lanka	78th
Bhutan	127th
India	130th
Bangladesh	130th
Nepal	145th
Myanmar	149th
Pakistan	168th

India's Human Development Achievements:

Health:

- **Life Expectancy** rose from **58.6 years (1990)** to **72 years (2023)**
- Key Programs: **Ayushman Bharat**, **Janani Suraksha Yojana**, **Poshan Abhiyaan**

Education:

- **Mean years of schooling** increased from **8.2 to 13 years**
- Boosted by: **Right to Education Act**, **Samagra Shiksha Abhiyan**, **NEP 2020**

Income:

- **GNI per capita** surged from **$2,167 (1990)** to **$9,046 (2023)**
- **135 million people** escaped **multidimensional poverty** (2015–2021)

Key Challenges Highlighted in HDR 2025:

AI and Human Development:

- AI should **augment human potential**, not replace it.
- Calls for **bold policy measures** to ensure **AI benefits everyone**.

Widening Global Inequalities:

- **Rising inequality** is slowing global progress.
- **India's HDI loss due to income inequality**: **30.7%** (among the highest in Asia)
- Persistent **gender disparities** in education, healthcare, and employment.

Key Policy Recommendations:

Three Action Areas:

1. **Complementarity Economy** – Foster collaboration between **humans and AI**
2. **Innovation for Capability Expansion** – Use AI to enhance **human creativity and productivity**
3. **Invest in Social Systems** – Prioritize **inclusive education**, **universal healthcare**, and **social protection**

Conclusion: The **HDR 2025** emphasizes that **human development is a matter of choice**—and in the **AI era**, we must choose to build a **fair, inclusive, and sustainable future**. India's progress is commendable, but the road ahead demands **deeper reforms**, **ethical AI use**, and **inclusive policies** to truly empower all citizens.

GS Paper 3 – Science & Technology

India Tightens Security Rules for Satellite Communication Service Providers

Context: India's **Department of Telecommunications (DoT)** has rolled out **stricter security and operational guidelines** for satellite communication (**satcom**) firms to enhance **data security**, **national sovereignty**, and the **integration of indigenous technologies**.

India Satellite Communication Guidelines: Latest Updates

The new norms impact companies such as **Starlink (Elon Musk)**, **Amazon's Project Kuiper**, **Eutelsat OneWeb**, and **Jio Satellite**. The guidelines focus on:

- **Data localisation**
- **NavIC integration**
- **Metadata collection**
- **Blocking non-compliant websites**
- **Local infrastructure mandates**

Key Compliance Requirements for Satcom Companies:

1. Local Manufacturing Mandate:

- Companies must submit a **phased manufacturing plan**.
- **20% indigenisation** of the **ground segment** is required within **five years** of commercial launch.

2. Integration of NavIC:

- Mandatory on a **best-effort basis** initially.
- **Full transition to NavIC** required by **2029**.
- Supports **India's autonomous navigation capability**.

3. Data Localisation Norms:

- All **user data** must be **stored within India**.
- No traffic should **route through foreign gateways, PoPs, or space systems** not authorized by India.
- **Data mirroring or decryption** outside India is strictly **prohibited**.

4. Website Blocking & Traffic Control:

- Firms must implement systems to **block access** to **government-identified websites**.
- Operators must comply with instructions to **restrict services** to individuals or regions during **emergencies or conflict**.

5. Law Enforcement Compliance:

- Satcom firms must:
  - Share **metadata** upon request.
  - Report any **foreign/unregistered terminals** operating in India.
  - Offer **real-time location tracking** (latitude–longitude) of all **user terminals**.

6. India-Based Infrastructure Mandate:

- All key infrastructure must be **India-hosted**, including:
  - **Data centers**
  - **DNS resolution**
  - **Lawful interception systems**
  - **Network control & monitoring tools**

Special Security Provisions:

Special Monitoring Zones (SMZs):

- Includes areas:
  - Within **50 km of international borders**
  - Coastal areas up to the **Exclusive Economic Zone (200 nautical miles)**
- Subject to **heightened surveillance** by security agencies.

Clearance for Communication Services:

- Launch of **voice or data communication services** requires **separate national security clearances**.

Strategic Intent Behind the Guidelines:

These guidelines reflect India's commitment to:

- **Digital Sovereignty**
- **Strengthening National Security**
- **Promoting Indigenous Technologies** (e.g., NavIC)
- **Boosting Local Manufacturing** in telecom and satellite infrastructure

Current Regulatory Landscape:

- **Starlink** is awaiting **final security clearance** to begin operations in India.
- Partnerships already formed with **Airtel** and **Jio**.
- The **Telecom Regulatory Authority of India (TRAI)** is finalizing a **satellite spectrum allocation framework**, which will further shape the satcom landscape.

GS Paper 1 – Geography

The Maldives: A Fragile Paradise in the Indian Ocean

Context: The **Maldives** is a **sovereign archipelagic nation** located in the **Indian Ocean**, consisting of **26 natural atolls** and over **1,000 coral islands**. The country lies to the **south-southwest of India**, and its **northernmost atoll** is strategically positioned close to the Indian subcontinent.

One of the notable maritime boundaries of the Maldives is the **Eight Degree Channel**, a crucial sea lane that separates the island of **Minicoy** (part of **India's Lakshadweep Islands**) from the northern Maldives. This channel is vital for **commercial and strategic navigation**.

Unique Geographical Features of the Maldives:

- **Coral Origins:** The entire nation is **formed by coral reefs**. It is among the few countries with **no rivers or mountains**, giving it a flat and fragile topography.
- **Reef Ecosystem:** The Maldives boasts the **seventh-largest coral reef system** in the world, contributing about **3.14%** of the **global coral reef coverage**. These reefs support a vibrant ecosystem and are a major tourist attraction.
- **Rising Sea Concerns:** With an **average elevation of only 1.7 meters** above **mean sea level**, the Maldives is one of the **most vulnerable nations** to **sea-level rise** caused by **climate change**. A one-meter rise in sea level could submerge most of the inhabited islands.

Why HADR Exercises Matter:

The joint HADR drill is not just a **military engagement**, but a **humanitarian partnership** aimed at improving **interoperability** in crisis situations like **cyclones, tsunamis**, or **coastal flooding**. These efforts equip both nations with shared strategies for **search and rescue operations**, **medical aid**, and **logistics support** during disasters.

Did You Know?

- The Maldives is the **lowest-lying country** in the world.
- The nation's **exclusive economic zone (EEZ)** spans over **900,000 sq. km**, despite its small land area—making its **marine resources** highly valuable.
- It was the **first country** to hold an underwater cabinet meeting (in 2009) to highlight the threat of **climate change**.

GS Paper 2 – Environment, Disaster Management

Kaleshwaram Project Under Scrutiny: Structural Damage Raises Safety Concerns

Context: In a recent development, the **National Dam Safety Authority (NDSA)**—India's apex body for dam safety—has reported **"irreparable structural damage"** in **three key barrages** of the **Kaleshwaram Lift Irrigation Project (KLIP)**. These findings have raised **serious concerns** over the long-term safety and sustainability of one of the **world's largest lift irrigation systems**.

Kaleshwaram Lift Irrigation Project: Engineering Marvel of Telangana:

The **Kaleshwaram Lift Irrigation Project (KLIP)** is a **multi-purpose mega infrastructure project** located on the **Godavari River** in **Kaleshwaram**, **Jayashankar Bhupalpally district**, **Telangana**. This project is designed to provide **irrigation water, drinking water**, and **industrial supply** to vast areas across the state.

- **Coverage:** It aims to serve **45 lakh acres** across **20 out of Telangana's 33 districts**, including the twin cities of **Hyderabad** and **Secunderabad**.
- **Scale:** KLIP is currently the **world's largest multi-stage lift irrigation project**, with a network that includes **seven links**, **28 construction packages**, and an **extensive canal system** spanning more than **1,800 km**.

Hydrological and Geographical Significance:

The project taps water from the **confluence** of the **Pranhita** and **Godavari rivers**, situated in northern Telangana. The **Pranhita River** is formed by the **joining of the Wardha, Wainganga, and Painganga rivers**, making it part of the **seventh-largest river basin** in the Indian subcontinent.

- **Total Water Lifted:** The project targets the **lifting and distribution** of approximately **240 TMC (Thousand Million Cubic Feet)** of water.
- **Utilization:** Water is allocated for **agriculture**, **municipal water supply**, **industrial use**, and **rural drinking water**.

Current Challenge: Damaged Barrages Raise Alarms

The NDSA's report has highlighted **structural failures** in three crucial **barrages**, potentially threatening the project's **long-term viability** and **public safety**. The damages are reportedly **beyond repair**, prompting calls for urgent **inspection**, **retrofits**, or **reconstruction** of key components.

Safety experts and **civil engineers** have voiced concerns about the **quality of construction**, **design standards**, and **monitoring mechanisms**, calling for a thorough **technical audit**.

Did You Know?

- KLIP uses **massive pumps** to lift water to heights of over **600 meters**, a feat that requires **enormous energy** and **sophisticated engineering**.
- The project's **cost** has been estimated at **over ₹80,000 crore**, making it one of the **most expensive** irrigation ventures in India.

- If fully operational and structurally sound, KLIP has the potential to **transform Telangana's agrarian economy** and ensure **water security** for decades.

Conclusion: A Moment of Reflection and Action

While the **Kaleshwaram Project** remains a **symbol of engineering ambition**, the recent findings serve as a **stark reminder** of the importance of **structural integrity**, **transparent governance**, and **sustainable planning**. Timely **intervention and accountability** will be crucial to protect both **public investment** and **regional livelihoods** dependent on this grand initiative.

Ancient Flames in Stone: Scientists Discover Palaeofire Evidence in the Godavari Basin

Context: In a remarkable discovery, scientists have found **evidence of palaeofires**—ancient wildfires dating back to the **Permian Period (~250 million years ago)**—in the **Godavari Basin**, shedding light on the role of wildfires in shaping Earth's **climate, ecosystems, and coal formation** over millions of years.

What Are Palaeofires?

Palaeofires are **wildfires from prehistoric times**, preserved in the **geological record**. These fossilized fire events provide crucial insights into:

- **Past vegetation dynamics**
- **Atmospheric oxygen levels**
- **Climate evolution**
- **Coal and carbon cycle formation**

The study, which spans from the **Late Silurian Period (443.8–419.2 million years ago)** to the **Quaternary Period (2.58 million years ago to present)**, shows how wildfires have continuously shaped Earth's landscapes and **carbon storage processes**.

Cutting-Edge Techniques Reveal Ancient Fire Signatures:

Researchers employed **advanced scientific methods** to analyze ancient **sedimentary rocks** for signs of wildfire activity:

- **Palynofacies Analysis** – Studied microscopic organic debris in sediments.
- **Raman Spectroscopy** – Examined the chemical composition of charcoal.
- **FTIR Spectroscopy** – Identified organic molecular structures.
- **Rock-Eval Pyrolysis** – Measured hydrocarbon generation potential of the samples.

These methods enabled scientists to identify **three key types of organic matter**:

1. **Translucent Organic Matter (TrOM):** Includes pollen grains and plant fragments.
2. **Palaeofire Charcoal (PAL-CH):** Solid evidence of past wildfires.
3. **Oxidised Charcoal (OX-CH):** Likely transported charcoal altered after the fire.

Key Discoveries and Geological Implications:

- The team successfully **differentiated between in situ (on-site)** and **ex situ (transported)** charcoal—resolving a major geological puzzle about the origin of charcoal in **coal seams**.
- **Stratigraphic layers** revealed clear patterns:
    - **Regressive phases** (falling sea levels): Well-preserved, concentrated charcoal deposits.
    - **Transgressive phases** (rising sea levels): More dispersed and oxidised charcoal, showing greater environmental reworking.
- The **Permian Period's high oxygen levels** made the planet **highly fire-prone**, increasing both the **intensity and frequency** of wildfires. These fires likely influenced **peat formation**, a precursor to coal.

India's Contribution: The Raniganj Coalfield Case:

- The **Raniganj Coalfield** in eastern India was among the **first regions** to show **macroscopic charcoal** in coal seams, confirming the existence of palaeofires in ancient **peat-forming environments** (known as **palaeomires**).

Why It Matters Today:

Understanding palaeofires helps us better comprehend the **global carbon cycle**, including how **carbon was stored** in ancient environments and how wildfires contributed to **long-term carbon sequestration**. This has direct relevance to:

- **Climate change studies**
- **Carbon cycling models**
- **Modern wildfire risk assessments**

Did You Know?

- Earth's highest atmospheric oxygen levels (~35%) occurred during the **late Paleozoic era**, making the **Permian Period one of the most fire-active epochs** in Earth's history.
- Fossil charcoal, though small, is incredibly **resilient**, and can **preserve fire evidence for hundreds of millions of years**.

This research not only **connects India's ancient geological past with global Earth history**, but also offers **valuable lessons** for managing carbon and understanding the potential **long-term impacts of wildfire activity** in our rapidly changing climate.

GS Paper 2 – Governance, Constitution, and Polity

Appointment to the Central Bureau of Investigation (CBI)

Context: A **high-level committee** led by the **Prime Minister of India** recently convened to select the next **Director of the CBI**. However, due to the **lack of consensus**, the **incumbent director** is likely to receive a **one-year extension**.

About the Central Bureau of Investigation (CBI):

Overview:

The **CBI** is India's premier **investigative agency**, tasked with probing high-profile crimes, corruption cases, economic offenses, and matters related to **national security**.

Origins & Evolution:

- Traces its roots to the **Special Police Establishment (SPE)** formed in **1941**, aimed at probing corruption in **wartime procurement**.
- Officially established in **1963** through an **executive order** based on the **Santhanam Committee's** recommendations.
- **Not a statutory body** — not created by an Act of Parliament.

Functioning:

- Operates under the **Department of Personnel and Training (DoPT)**, Ministry of Personnel, Public Grievances and Pensions.
- Derives investigative authority from the **Delhi Special Police Establishment (DSPE) Act, 1946**.
- **Exempt from the Right to Information (RTI) Act** for sensitive cases.

Jurisdiction:

- CBI requires **state government consent** to investigate within state jurisdictions.
- **Supreme Court and High Courts** can direct CBI to investigate anywhere in India **without state consent**.
- CBI can **suo moto** investigate cases **only in Union Territories**.

Organizational Structure:

Director of CBI:

- Appointed by the **Central Government** on the recommendation of a **high-level selection committee**.
- Holds authority over all operations, policy decisions, and organizational matters.
- Maximum tenure: **5 years**.

Specialized Divisions:

- **Anti-Corruption Division**
- **Economic Offenses Division**
- **Special Crimes Division**
- **Directorate of Prosecution**
- **Policy & Coordination Division**

- **Central Forensic Science Laboratory (CFSL)**

Regional Offices: Located across India and headed by **Joint Directors** or **Additional Directors**.

International Role: Acts as the **nodal agency** for **Interpol**, handling **cross-border investigations**.

Appointment Process of the CBI Director:

Selection Committee Composition:

1. **Prime Minister of India** (Chairperson)
2. **Chief Justice of India (CJI)**
3. **Leader of the Opposition (LoP)** in Lok Sabha

Legal Basis:

- Governed under the **DSPE Act, 1946**.
- Appointment is approved by the **Appointments Committee of the Cabinet**.

Key Concerns and Challenges:

Jurisdiction & Consent Issues:

- Many states have **withdrawn general consent**, weakening the CBI's capacity for **independent investigations**.
- Frequent **legal disputes** over its jurisdiction.

Supervision and Political Interference:

- Reports to **Central Vigilance Commission (CVC)** and the **DoPT**.
- The **Supreme Court** once described CBI as a **"caged parrot"**, indicating its lack of autonomy.

Delays in Investigations: Bureaucratic red tape and legal complexities often cause **delays in high-profile cases**.

Manpower Shortage: Around **16% vacancies** in sanctioned posts; challenges in recruitment and **deputation** from state services.

Deputation Issues:

- States are often **reluctant to release personnel** for CBI duty, particularly at the **sub-inspector level**.

Way Forward: Recommendations from the Parliamentary Committee

- **New Legislation:** Enact a **dedicated law** to define CBI's **powers, structure, and functions**, replacing the outdated DSPE Act.

Structured Recruitment Framework:

- Ensure regular **monitoring of recruitment** and fill vacancies swiftly.
- Invest in **advanced forensic and training facilities**.
- **National Security Provisions:** Introduce a **new law** allowing CBI to probe **national security-related offenses** without seeking state consent.

Conclusion: The **CBI** plays a critical role in maintaining **law and order**, **curbing corruption**, and handling **sensitive national cases**. However, concerns related to its **autonomy, jurisdiction**, and **efficiency** remain pressing. Structural reforms, **legal clarity**, and better **manpower planning** are vital to restore the CBI's stature as an **independent and effective investigative agency**.

GS Paper 3 – Science & Technology, Environment

Hydrogen vs Battery: The Future of Clean Fuel in Transportation

Context: As the global push for **sustainable transportation** accelerates, two prominent contenders have emerged:

- **Battery Electric Vehicles (BEVs)**
- **Hydrogen Fuel Cell Electric Vehicles (FCEVs)**

While **BEVs** currently dominate the market, **FCEVs** are gaining attention for their **longer range**, **quick refueling**, and **adaptability to harsher climates**.

Battery Electric Vehicles (BEVs):

- Powered by **electricity stored in rechargeable batteries**.
- Require **regular charging** via external sources like **home chargers** or **public charging stations**.
- Emit **zero tailpipe emissions**, making them eco-friendly.
- Examples: Tesla, Tata Nexon EV, MG ZS EV.

Fuel Cell Electric Vehicles (FCEVs):

- Run on **hydrogen gas**, which generates electricity through a **chemical reaction** in a fuel cell.
- Emit **only water vapor**, making them a **clean and efficient** solution.
- Suitable for **heavy-duty** and **long-range** applications.
- Examples: Toyota Mirai, Hyundai NEXO.

Hydrogen vs Battery: A Feature-wise Comparison

Feature	Battery Electric Vehicles (BEVs)	Hydrogen Fuel Cell Vehicles (FCEVs)
Refueling Time	Several hours (depending on charger)	**5–15 minutes**
Driving Range	Moderate (150–400 km)	**Longer (500–700+ km)**
Vehicle Weight	**Heavier** (large battery packs)	**Lighter**
Terrain Suitability	Less suited for rough terrain	**Better for rugged/off-road use**
Cold Climate Performance	Performance decreases	**Performs better** in cold temperatures

India's Electric Vehicle Landscape: 2023 Highlights

- **EV Adoption:** Electric Vehicles made up **5% of total vehicle sales** in India.

Electric Three-Wheelers:

- India became the **world's largest market** in 2023, surpassing China.
- Accounts for a staggering **60% of global sales** in this segment.

Electric Two-Wheelers:

- India ranks **second globally**, with **0.88 million units sold** in 2023.
- **China** leads with **6 million units** sold.

Global Leaders: India, China, and ASEAN nations dominate the **2- and 3-wheeler EV** segment, while **rest of the world contributes less than 5%**.

Conclusion:

Both **BEVs and FCEVs** offer **clean and sustainable** alternatives to fossil fuel vehicles.

- **BEVs** are currently more popular due to **charging infrastructure** and **urban use**.
- **FCEVs**, with faster refueling and better performance in **long-range and rugged conditions**, could be the **future for heavy transport and rural mobility**.

GS Paper 3 – Environment and Biodiversity

Saola: The Elusive Asian Unicorn

Context: Scientists have successfully **mapped the genome** of the Saola using **tissue fragments** from hunter-collected remains.

- **Significance:** First-ever full genome mapping of this species, aiding **genetic conservation and recovery planning**.

About Saola (Pseudoryx nghetinhensis):

- **Discovered:** 1992, during a WWF and Vietnamese Ministry of Forestry expedition.
- **Nickname:** "Asian Unicorn" due to its **rarity and elusive nature**.
- **Appearance:**
  - Long, **parallel horns** (up to 20 inches), found in **both sexes**.
  - **Distinct white facial markings**.
- **Status:** *Critically Endangered* – IUCN Red List (Estimated **50–300 individuals**, 2015).

Habitat and Distribution:

- **Region:** Found **only** in the **Annamite Mountains** along the **Vietnam–Laos border**.
- **Ecosystem:** Dense, mist-covered **evergreen forests** with little to no dry season.
- **Biodiversity Hotspot:** Region supports many endemic and endangered species.

Major Threats:

- **Snaring & Poaching:** Widespread use of wire snares for bushmeat.
- **Deforestation:** Driven by agriculture, logging, and burning.
- **Habitat Fragmentation:** Isolates populations, lowers breeding success.
- **Low Reproductive Rate:** Naturally limits population recovery.

Importance of Genome Mapping:

- **Source Material:** DNA recovered from **remains in hunter households**.
- **Sample Size:** Genetic data from **26 individuals**.
- **Outcome:** Helps determine:
  - **Genetic diversity**
  - **Population structure**
  - **Inbreeding risk**
  - **Conservation planning**

Key Genetic Insights:

- **Historical Population Split:** Two genetic lineages diverged **5,000–20,000 years ago**, likely due to forest changes post-Ice Age.
- **Human Impact:** Rise of agriculture (~4,000 years ago) accelerated habitat loss and hunting, increasing isolation.
- **Complementary Gene Pools:**
    - Each group lost **different segments** of diversity.
    - Combining both lineages may **restore lost genetic variation**, aiding species survival.

Conservation Outlook:

- Genome mapping provides a **critical tool** for future conservation strategies, possibly including:
    - **Captive breeding** programs
    - **Rewilding efforts**
    - **Genetic rescue** and **habitat corridor** design

GS Paper 3 – Science & Technology

Northeast India's First Geothermal Production Well – Dirang, Arunachal Pradesh

Location: Dirang, **Arunachal Pradesh**

- **Executed by:** Centre for Earth Sciences and Himalayan Studies (CESHS)
- **Significance: First successful geothermal production well** in the **northeastern region of India**

International Collaboration:

- **Partners:**
  - CESHS (India)
  - **Norwegian Geotechnical Institute (NGI)**, Oslo
  - **Geotropy ehf** (Icelandic geothermal firm)
  - **Guwahati Boring Service (GBS)** – Indian drilling team

About Geothermal Energy:

- **Definition:** Energy harnessed from **heat beneath the Earth's surface**
- **Sources of Heat:**
  - **Radioactive decay** of minerals
  - **Residual heat** from Earth's formation
- **Applications:**
  - **Electricity generation**
  - **Direct heating and cooling**

Advantages:

- **Renewable & Clean**
- **Operates Year-Round** (base-load energy source)
- **Low Carbon Footprint**

Disadvantages:

- **Land subsidence risk**
- **High energy transmission costs (remote locations)**
- **Risk of toxic gas or chemical emissions**

Geothermal in India: Current Scenario:

- **Geothermal Atlas of India (2022)** by GSI identifies potential sites.
- **MNRE's RE-RTD Programme** promotes indigenous R&D in geothermal and other renewables.
- **Telangana Pilot Project:**
  - 20 kW geothermal plant by **Singareni Collieries** in **Manuguru**, Bhadradri Kothagudem.

Major Geothermal Locations in India:

Some prominent geothermal provinces (per Geothermal Atlas):

- **Himalayan Region** – Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Arunachal Pradesh
- **Sohana Region** – Haryana
- **Cambay Graben** – Gujarat
- **Son-Narmada-Tapti (SONATA)** – Central India
- **Godavari Basin** – Andhra Pradesh
- **West Coast Belt** – Maharashtra
- **Andaman & Nicobar Islands**

Conclusion:

The successful drilling in Dirang represents a **pivotal step toward geothermal development in the Northeast**, backed by global collaboration. With rising energy demands and climate challenges, such renewable breakthroughs offer a sustainable path forward.

GS Paper 2 – Governance, Constitution, and Polity

Jharkhand & the Triple Test for OBC Reservation in Urban Local Bodies

Context: Jharkhand has completed **data collection** to implement OBC reservations in Urban Local Bodies (ULBs) in accordance with the **Supreme Court-mandated "Triple Test"**.

- This paves the way for **constitutionally compliant** OBC quotas in urban governance.

What is the "Triple Test"?

Origin: Laid down by the **Supreme Court** in *Vikas Kishanrao Gawali vs State of Maharashtra (2021)*

3 Mandatory Steps for Valid OBC Reservation in Local Bodies:

1. **Empirical Inquiry:** A **dedicated commission** must conduct detailed, data-based analysis of OBC backwardness in local bodies.
2. **Data-Based Quota:** Reservation quantum should be based on the commission's findings—not arbitrary.
3. **Reservation Cap:** Total quota for **SCs + STs + OBCs** must **not exceed 50%** of seats in ULBs.

Progress in Jharkhand:

- **OBC Commission Formed:** Established in **June 2023**
- **Data Collection Period: Dec 2023 – March 2024**
- **Comparative Approach:** Studied **Madhya Pradesh's** triple test model
- **Delays:** Some districts missed deadlines; final report pending due to **Chairperson's post being vacant**

Next Steps:

- Analysis by institutions like **XLRI**, **XISS**, and **IIMs**
- Final verified report to be submitted to the **state government**

Survey Methodology:

- **Scope:** Urban areas only; not a full caste census
- **Approach:**
  - **Door-to-door** identification of OBC households
  - Political representation review (past 25 years of ULB data)
  - Historical winners (general vs reserved seats)

OBC Population in Jharkhand:

- **Approx. 50%** of the population
- **Main OBC Groups:**

  - **BC-I:** More socially/educationally backward (127 castes)
  - **BC-II:** Relatively better-off (45 castes)
- **Largest Group: Kudmi/Mahato** (~15% of electorate)

Conclusion:

If implemented effectively, Jharkhand's **Triple Test compliance** could:

- Become a **model for other states**
- Promote **data-driven policy**
- Enhance **inclusive representation** in urban governance

ITBP Successfully Summits Mt. Makalu – The World's Fifth Highest Peak

Context: The **Indo-Tibetan Border Police (ITBP)** successfully scaled **Mt. Makalu,** the fifth highest peak in the world.

About Mt. Makalu:

- **Mt. Makalu**, standing tall at **8,485 meters**, is the **fifth highest mountain** in the world.
- It lies in the **Mahalangur range** of the **Nepal Himalayas**, along the border between **Nepal** and the **Tibet Autonomous Region of China**.
- Located **southeast of Mt. Everest**, the mountain is known for its **distinctive pyramid-shaped peak** and **four razor-sharp ridges**.
- The peak rises majestically within the **Makalu Barun National Park**, offering panoramic views of the lush **Barun Valley**—a hotspot of **biodiversity** and **glacial beauty**.
- **Subsidiary Peaks**: Makalu includes **two significant sub-peaks**, **Makalu II** (7,678 m) and **Kangchungtse**, located approximately **3 km** from the main summit.

Historical Significance:

- **First Ascent**: Mt. Makalu was **first climbed in 1955** by a **French expedition** led by **Jean Franco**.
- It remains one of the **most technically demanding peaks** to scale due to its **steep pitches, sharp ridges**, and **exposure to high-altitude weather hazards**.

ITBP's Achievement:

- The **Indo-Tibetan Border Police (ITBP)** has now **successfully conquered Mt. Makalu**, adding another milestone to its legacy of high-altitude excellence.
- This marks the **6th 'eight-thousander'** scaled by the ITBP out of the **14 peaks above 8,000 meters** on Earth.
- To date, the force has climbed **229 Himalayan peaks**, including:
    - **Mt. Everest (8,848 m)**
    - **Mt. Kanchenjunga (8,586 m)**
    - **Mt. Dhaulagiri (8,167 m)**
    - **Mt. Lhotse (8,516 m)**
    - **Mt. Manaslu (8,163 m)**

About ITBP:

- The **Indo-Tibetan Border Police** is one of India's **Central Armed Police Forces**, functioning under the **Ministry of Home Affairs**.
- Specialized in **high-altitude operations**, the ITBP is tasked with guarding the **3,488 km-long India-China border** in some of the world's **harshest terrains**.

- Besides security, ITBP personnel are known for their **mountaineering expertise**, **disaster response**, and **rescue missions** in remote, inaccessible regions.

Did You Know?

- **Makalu's name** is derived from the **Sanskrit word 'Maha-Kala'**, a form of Lord Shiva, meaning **'Great Black'**—likely referring to the mountain's **dark, forbidding appearance**.
- The **Barun Valley**, nestled below Mt. Makalu, is one of the **few places on Earth where tropical forests meet ice-covered peaks**, making it a **UNESCO-recognized biodiversity hotspot**.

A Testament to Human Spirit:

The ITBP's successful ascent of **Mt. Makalu** not only highlights **India's mountaineering prowess** but also symbolizes the **resilience, discipline, and courage** of the force that tirelessly guards our borders under **extreme weather and terrain conditions**.

GS Paper 2 – Governance, Constitution, and Polity

President Highlights the Role of Mediation in Reducing Judicial Burden

Context: At the **first National Mediation Conference** organized by the **Mediation Association of India (MIA)**, the **President of India** strongly emphasized the growing importance of **mediation** as a tool to resolve disputes, reduce litigation costs, and ease the **overburdened court system**.

What is Mediation?

Mediation is a **voluntary, confidential, and non-adversarial** process where a **neutral third party** (mediator) assists disputing individuals or parties in arriving at a **mutually acceptable solution**.

It is one of the key pillars of **Alternative Dispute Resolution (ADR)**, alongside:

- **Arbitration**
- **Conciliation**
- **Negotiation**

India's Judicial Backlog: A Crisis in Numbers

The Indian judiciary is currently struggling under a **mountain of pending cases**:

- **5.1 crore+ total pending cases** (as of 2024)
  - **71,000** in the **Supreme Court**
  - **60 lakh** in **High Courts**
  - **4.5 crore** in **District and Subordinate Courts**
- Judge Vacancy: Out of ~25,000 sanctioned judges, only ~20,000 are in place (**~20% shortfall**)
- **Judge-to-population ratio**: Only **21 judges per million**, far short of the **Law Commission's recommendation** of **50 per million**

Why Mediation Matters:

Mediation offers a practical, humane, and sustainable approach to dispute resolution:

- **Reduces Court Pendency**: Ideal for minor **civil**, **commercial**, and **family** disputes
- **Time-Efficient**: Resolutions are often reached within **a few sessions**
- **Cost-Effective**: Cuts down on **legal fees** and **court expenses**
- **Relationship-Friendly**: Preserves **personal and business ties**
- **Empowering**: Parties retain **control over the outcome**, rather than having a solution imposed

Legal and Institutional Support:

Mediation in India is supported by several key **laws and frameworks**:

- **Legal Services Authorities Act, 1987**: Created **Lok Adalats** using mediation-like techniques
- **Section 89, Civil Procedure Code (1908)**: Courts **mandated** to refer cases for ADR
- **Mediation Act, 2023** (Landmark legislation)
  - **Mandatory pre-litigation mediation** in civil & commercial matters
  - Formation of the **Mediation Council of India (MCI)** for:

- Standardizing training & accreditation
- Regulating mediation institutions
- Monitoring mediator conduct and case outcomes

Mediation in Current Legal & Commercial Disputes:

- **Commercial Courts Act, 2015**: Fast-tracks commercial cases above ₹3 lakh and promotes **pre-litigation mediation**
- **Arbitration and Conciliation Act, 1996** (with 2015, 2019, 2021 amendments): Encourages **binding arbitration**, both **ad hoc** and **institutional**
- **Consumer Protection Act, 2019**: Emphasizes **mediation** as a primary dispute resolution tool
- **Singapore Convention on Mediation**: India's participation paves the way for **cross-border enforcement** of mediated settlements

The Way Forward:

To make mediation a **mainstream judicial tool**, India must:

1. **Strengthen Legal Infrastructure**: Ensure **uniform and effective implementation** of the Mediation Act, 2023
2. **Boost Awareness**: Launch nationwide **mediation literacy campaigns**
3. **Train Mediators**: Scale up **capacity building** with standardized **certification**
4. **Judicial Backing**: Encourage **active referrals by judges** to mediation centers
5. **Go Digital**: Promote **Online Dispute Resolution (ODR)** for convenience and speed
6. **Track Progress**: Build **national databases** to assess mediation outcomes and their impact on court backlog

Conclusion:

The President's address underscores a **pivotal shift** in India's legal landscape. **Mediation is not merely an alternative**—it is an **essential path** to **accessible**, **timely**, and **empathetic justice**. As India advances, a **robust mediation ecosystem** can transform how we resolve conflicts, preserve relationships, and uphold the rule of law.

GS Paper 3 – Science & Technology

Genome-Edited Rice Varieties: India's Leap Toward a Second Green Revolution

Context: In a landmark announcement, the **Union Agriculture Minister** introduced **two genome-edited rice varieties**, signaling a **new era in agricultural innovation** that could ignite the **Second Green Revolution** in India.

What is Genome Editing?

Genome editing is a cutting-edge biotechnological method that enables **precise alterations in the DNA** of living organisms. The most notable tool in this domain is:

- **CRISPR-Cas9** (*Clustered Regularly Interspaced Short Palindromic Repeats – associated protein 9*):
    - Acts like **molecular scissors** to remove, insert, or modify genetic material with pinpoint accuracy.
    - Unlike **Genetically Modified Organisms (GMOs)**, it doesn't require **foreign DNA** insertion, making it more **biologically natural and acceptable** under Indian biosafety regulations.

In India, **SDN-1** and **SDN-2** techniques (which do not introduce foreign genes) are permitted for general crops.

India's First Genome-Edited Rice Varieties:

Developed by **ICAR (Indian Council of Agricultural Research)**, the two new varieties are:

- **DRR Rice 100 (Kamla)**
- **Pusa DST Rice 1**

These are outcomes of CRISPR-based research that began in 2018 under the **National Agricultural Science Fund**, targeting **Samba Mahsuri** and **MTU 1010** rice lines.

Benefits of Genome-Edited Rice:

Impact Area	Benefit
Yield	**19% increase**
Water Use	Saves **7,500 million cubic meters** of irrigation water
Greenhouse Gas Emissions	**20% reduction**, especially in methane
Climate Resilience	Tolerant to **drought, salinity, and heat**
Pest & Disease Resistance	Less dependence on **chemical pesticides & fertilizers**

Understanding CRISPR Technology:

- Inspired by **natural bacterial immunity**, CRISPR identifies and destroys **invading viral DNA**.
- In agriculture, it helps in:
    - Developing **disease-resistant** crops

- Improving **nutritional quality**
- Enhancing **climate adaptability**

Path to a Second Green Revolution:

First Green Revolution	Second Green Revolution (Genome-Editing)
High-yielding wheat & rice varieties	**Precision-edited, climate-resilient crops**
Water-intensive, heavy chemical usage	**Efficient resource use**, lower environmental footprint
Increased productivity, but ecological stress	Sustainable yield with **minimal ecological harm**
Focused on food security	Focused on **food security + climate adaptation + sustainability**

Challenges & Concerns:

- **Global Regulatory Uncertainty**: Not all countries accept genome-edited crops, limiting **exports**.
- **Corporate Monopolies**: Risk of **private control** over patented technologies and seeds, raising **costs for farmers**.
- **Biodiversity Risk**: Over-reliance on select varieties could threaten **agro-genetic diversity**.

Way Forward:

1. **Boost R&D Investment**: 500 crore allocated in the **2023–24 Union Budget** for crop genome editing.
2. **Expand Public Sector Role**: ICAR is now extending genome-editing research to **oilseeds**, **pulses**, and **horticultural crops**.
3. **Public-Private Partnerships**: Encourage joint ventures for **responsible innovation**.
4. **Farmer & Scientist Training**: Build national capacity for **safe, inclusive use** of genome-editing tools.
5. **Streamlined Regulation**: Ensure transparent, science-based policies to **balance safety and innovation**.

Conclusion:

Genome-editing marks a **revolutionary stride** in India's agricultural transformation. With a focus on **higher yields, sustainability, and climate resilience**, these innovations can propel India into a **future of food security**, **farmer welfare**, and **eco-friendly farming**—without repeating the ecological mistakes of the past.

GS Paper 3 – Environment, Agriculture

Agriphotovoltaics: Powering Farms with the Sun

Context: On **World Solar Day (May 3rd)**, attention turned to the transformative role of **solar energy in agriculture**, with **Agriphotovoltaics (APVs)** emerging as a powerful innovation to address **climate, food, and energy security**.

What are Agriphotovoltaics (APVs)?

Agriphotovoltaics refers to the **simultaneous use of land** for **solar energy production and agriculture** by **elevating solar panels** over crop fields. This integrated model:

- Increases **land-use efficiency**
- Creates **microclimates** for better crop resilience
- Enables **dual income streams** for farmers

Origin: Concept first introduced by German scientists **Adolf Goetzberger and Armin Zastrow in 1981**.

India's Solar Growth Milestones:

- **3450% growth** in solar capacity in a decade
- **100.33 GW** achieved as of **January 2025**
- **2024 solar boom**:
  - **24.5 GW** added (2x increase from 2023)
  - **18.5 GW utility-scale** installations

Benefits of APVs for Farmers:

Benefit Area	Details
Water Efficiency	Solar panels reduce evaporation by creating shade
Climate Resilience	Shields crops from heat and erratic weather
Stable Incomes	Lease land to solar companies or sell electricity via feed-in tariffs
Crop Growth	Suitable for **shade-tolerant crops** (e.g., **potatoes, tomatoes, turmeric**)
Income Potential	1.5 lakh/acre vs 25,000 from traditional farming in Delhi pilot

APV in Action: India's Pilot Success:

- **Najafgarh, Delhi Project**:
  - Farmer leases land for 1 lakh/acre/year
  - Dual income from **crop + solar lease** or **solar power sales**

Scaling Up APVs: Policy and Support Needed:

1. **Revamp PM-KUSUM Scheme**:
   - Integrate **APV models** into existing solarisation programs
   - Promote **grid-connected dual-use solar plants**
2. **Financial Incentives**:
   - Credit support & subsidies for **smallholder farmers** (<2 ha)

- Increase **feed-in tariffs** for APV-generated solar power

3. **Farmer Training**:
   - Government-led programs on **APV installation & management**
   - Encourage community-level **solar farming cooperatives**
4. **Research & Customization**:
   - Expand **pilot programs** across **different agro-climatic zones**
   - Develop **crop-specific APV designs**

Challenges:

Challenge	**Description**
Pilot-Scale Only	Currently limited to research and demonstration projects
High Initial Costs	Need for affordable financing and better risk coverage
Policy Gaps	No dedicated **agrivoltaics policy** in India
Lack of Awareness	Farmers and institutions unfamiliar with APV benefits

Future Outlook:

- Align APVs with India's **Net Zero** and **Doubling Farmers' Income** goals
- Integrate APVs into **national agricultural and climate strategies**
- Promote **public-private partnerships (PPPs)** to expand infrastructure
- Launch **awareness campaigns** to popularize APV potential

Conclusion: Agriphotovoltaics offer a **win-win model** for India: **Higher farmer incomes**, **climate-adaptive agriculture**, and **renewable energy expansion**—all from the same piece of land.

GS Paper 3 – Environment and Ecology

New Rules for Access and Benefit Sharing (ABS) of Biodiversity – 2025

Context: The **National Biodiversity Authority (NBA)** has notified the **2025 ABS Regulation** to streamline **fair and equitable sharing of benefits** from the use of India's biological resources and associated traditional knowledge.

- Aligned with India's commitments under the **Convention on Biological Diversity (CBD)** and the **Biological Diversity Act, 2002** (amended in 2023).

What is Access and Benefit Sharing (ABS)?

ABS is a global framework to:

- Regulate **access to biological resources** (plants, animals, microbes, etc.)
- Ensure **benefits are shared fairly** with local and indigenous communities who conserve and hold traditional knowledge.

Key Provisions of the 2025 Regulation:

Turnover-Based Benefit Sharing (for commercial users):

Annual Turnover	Benefit-Sharing Rate
Below 5 crore	Exempt
5–50 crore	0.2% of ex-factory annual turnover
50–250 crore	0.4% of turnover
Above 250 crore	0.6% of turnover

- Entities with **>1 crore turnover** must **file annual usage statements**.

Inclusion of Digital Sequence Information (DSI):

- **DSI** now recognized under ABS—includes **genetic codes and digital data** of biological resources.
- Aligns with global consensus from **CBD COP16 (Cali, Colombia)**.

Exemptions:

- **Cultivated medicinal plants** exempted—if **officially notified** by Ministry of Environment in consultation with **AYUSH Ministry**.

High-Value & Threatened Resources:

- **Red sanders, sandalwood, agarwood**, etc.:
  - **Minimum 5%** of sale/auction proceeds to be shared.
  - Can rise to **20%** in case of **commercial exploitation**.

Intellectual Property Rights (IPR):

- Mandatory disclosure of biodiversity use in patent/IP applications.
- **Benefit-sharing triggered upon commercialization** of inventions using biological resources.

Distribution of Shared Benefits:

- **10–15% retained** by **NBA** for administration.
- Remainder flows to **local communities via Biodiversity Management Committees (BMCs)**.

Significance of the New Rules:

Benefit Area	Explanation
Transparency	Clear, predictable benefit-sharing slabs for industries
Regulatory clarity	DSI inclusion plugs a critical legal loophole in earlier ABS frameworks
Promotes cultivation	Incentivizes **farming medicinal plants** over unsustainable wild harvesting
Community benefit	Ensures **economic returns** reach indigenous/local biodiversity custodians

Way Forward:

- Monitor implementation through **BMCs** and **State Biodiversity Boards**.
- Promote **capacity-building** for communities to assert benefit claims.
- Encourage **research and innovation** while upholding equitable sharing norms.

GS Paper 1 – Geography

Angola: A Nation of Strategic Importance and Growing Defense Ties with India

Geopolitical Overview of Angola:

- **Capital**: **Luanda**
- **Location**: **Southwestern Africa**
- **Neighboring Countries**:
  - **Republic of the Congo** (North)
  - **Democratic Republic of the Congo** (Northeast)
  - **Zambia** (Southeast)
  - **Namibia** (South)
- **Maritime Boundary**: **Atlantic Ocean** (West)

Geographical Features & Natural Resources:

Angola is endowed with **rich natural resources**, which are pivotal to its economy:

- **Petroleum**, **diamonds**, **iron ore**, **phosphates**, **copper**, **feldspar**, **gold**, **bauxite**, and **uranium**.
- Major **rivers** include the **Zambezi**, **Cuango** (Kwango), and **Cuanza** (Kwanza) rivers. The **Cuango River** forms part of the boundary between Angola and the **Democratic Republic of the Congo**.

Climate:

- **Tropical Climate** with a marked dry season. The climate is influenced by the **cold Benguela Current**, which flows northwards along the **southern African coast**, bringing cooler air and affecting precipitation patterns.

Angola-India Defense Relations:

- Recently, **India** announced a **$200 million defense credit line** to Angola, marking a significant step in strengthening defense and strategic ties between the two nations.

Extra Insight: Angola's Strategic Position in Africa

Angola, with its strategic location in **southern Africa**, plays a critical role in the region's **geopolitics**. As one of Africa's largest oil producers, Angola has become a vital partner for energy, trade, and defense relations, especially with countries like **India**, **China**, and **Russia**. The increasing **defense collaboration** highlights Angola's growing importance as a security partner in the **African continent**.

GS Paper 1 – Ancient Indian History

The Satavahana Dynasty: A Glimpse into Ancient Deccan Culture and Politics

Context: Recently, the **Archaeological Survey of India (ASI)** uncovered **11 ancient inscriptions** in **Peddapalli**, **Telangana**, which are attributed to the **Satavahana dynasty**. These inscriptions, dating from the **1st BCE to the 6th CE**, are written in **Brahmi script** and **Prakrit language**, offering valuable insights into the political, cultural, and religious practices of the era. These findings also confirm **Telangana's historical ties** to **Asmaka**, one of the **sixteen Mahājanapadas** (ancient Indian republics).

The Satavahana Dynasty: Key Facts

- **Time Period**: **1st Century BCE to the Early 3rd Century CE**
- **Location**: Initially centered around **North Maharashtra** and later expanding to **Karnataka** and **Andhra Pradesh**.
- **Significance**: The Satavahanas succeeded the **Maurya Empire** in the **Deccan** and **Central India**. Though mentioned as **Andhras** in the Puranas, the Satavahanas themselves did not use this term in their inscriptions.

Notable Rulers and Their Achievements:

Simuka (60 BCE - 37 BCE):

- Founder of the **Satavahana dynasty** and recognized as the first ruler in the **Naneghat inscription**.

Gautamiputra Satakarni (AD 106 - 130):

- Regarded as the greatest ruler of the **Satavahanas**.
- Defeated the **Shakas** and obliterated the **Kshaharata** dynasty.
- Expanded the empire from **Malwa** to **Karnataka**.
- Re-struck coins of defeated Kshaharata ruler **Nahapana**, symbolizing conquest.

Vashishthiputra Pulumayi (AD 130 - 154):

- Shifted the capital to **Paithan** (modern-day **Pratishthan**) on the Godavari River.
- Fostered alliances, including a marriage to **Rudradaman's** daughter to stop conflicts with the **Western Kshatrapas**.

Yajna Sri Satakarni (AD 165 - 194):

- Regained lost territories and promoted **maritime trade**.
- His coins depicted **ships**, highlighting the peak of his **maritime activity**.

Cultural and Technological Contributions:

- **Material Culture**: The **Satavahanas** are known for their **iron tools** such as **hoes**, **ploughshares**, and **arrowheads**, which contributed to agricultural advancements, particularly **paddy transplantation** in the **Krishna-Godavari** delta.
- **Trade**: Urbanization in cities like **Peddabankur** (200 BCE - 200 CE) saw the construction of **brick structures**, **underground drainage**, and **wells**, reflecting the increasing complexity of the region's infrastructure and trade. Roman and Satavahana coins were found in the region, signifying strong **trade relations**.

Social and Religious Life:

- **Social Structure**: Initially a tribal kingdom, the **Satavahanas** became **Brahmanized**, re-establishing the **varna system**. Their society exhibited a **matrilineal influence**, with kings often named after their mothers.
- **Religious Practices**: The **Satavahana rulers** were staunch **Brahmanas**, patronizing **Vedic rituals** and worshiping gods like **Krishna** and **Vasudeva**. However, they were also strong patrons of **Buddhism**, with land grants made to **Buddhist monks** in places like **Nagarjunakonda** and **Amaravati**.

Art and Architecture:

- The **Satavahanas** are noted for their **rock-cut architecture**, including significant **Chaityas** and **Viharas** like the **Karle Chaitya** and **Nasik Viharas**.
- They supported the **Amaravati School of Art**, famous for its detailed and **narrative sculptures** of the **Buddha's life**.
- **Inscriptions** from **Naneghat** and **Karle** highlight their deep religious patronage, especially towards **Buddhism**.

Language and Literature:

- The **official language** of the Satavahanas was **Prakrit**, and their inscriptions were written in the **Brahmi script**.
- The **Gathasattasai**, a **Prakrit text** attributed to King **Hala**, contains **700 verses** and is one of the most notable literary works of the time.

Decline and Legacy:

- The **Satavahana dynasty** started to decline around the **3rd century CE**. They were succeeded by the **Ikshvakus** in the **Eastern Deccan**, who continued many of the Satavahana traditions, especially in their patronage of **Buddhism**.
- Following the decline, the **Pallavas** emerged as prominent rulers in the **southern Deccan**.

Conclusion:

The discovery of these **Satavahana inscriptions** in **Telangana** provides a deeper understanding of the dynasty's **political, religious, and cultural impact**. Known for their **military prowess**, **support for Buddhism**, and **contributions to trade and urbanization**, the **Satavahanas** played a pivotal role in shaping the early history of the **Deccan** region. Their legacy lives on in the **Ikshvakus**, who carried forward the dynasty's cultural and administrative practices, particularly in Buddhist patronage.

GS Paper 3 – Science and Technology

Brain-Computer Interface (BCI): Restoring Movement for the Paralysed

Context: In a groundbreaking advancement, researchers at the **University of California** have developed a **new Brain-Computer Interface (BCI)** that allows people with **paralysis** to regain **movement** using robotic limbs—bridging brain signals directly to external devices.

What is a Brain-Computer Interface?

A **Brain-Computer Interface (BCI)** is a system that creates a **direct communication link** between the **brain's electrical activity** and an **external device**—bypassing the body's damaged motor pathways.

- **Purpose**: To **assist**, **augment**, or **restore** sensory-motor and cognitive functions.
- In this breakthrough, the **BCI decodes signals** from the brain's **motor cortex** using **Artificial Intelligence (AI)** to control **robotic limbs**.

Types of Brain-Computer Interfaces:

1. Invasive BCI:

- **Implanted directly** into the brain tissue.
- Provides **highly accurate signals**.
- Used in severe cases like **paralysis** or **locked-in syndrome**.
- **Example**: *Neuralink's Blindsight*, which explores restoring vision and movement.

2. Partially Invasive BCI:

- Placed **within the skull** but **outside the brain tissue**, typically on the **dura mater**.
- Uses techniques like **electrocorticography (ECoG)** to record signals.
- Offers a **balance** between signal quality and risk.

3. Non-Invasive BCI:

- Requires **no surgery**; uses external sensors like **EEG electrodes**.
- More **accessible and safer**, but less precise.
- Ideal for general use in **assistive technologies** and **education**.

Applications of BCI Technology:

Medical & Rehabilitation:

- **Assistive Devices**: Let users control **wheelchairs**, **robotic arms**, or **computers** with their minds.
- **Neurorehabilitation**: Stimulates brain areas post-stroke to **regain motor control**.
- **Prosthetics**: Enables brain-operated **artificial limbs**.

Education & Training:

- **Attention Monitoring**: Helps track **student engagement** in classrooms.
- **Skill Learning**: Offers **real-time feedback** on brain activity during learning or simulations.

Industry & Automation:

- **Human-Robot Collaboration**: Enhances **efficiency and safety** in automated environments.

- **Hands-Free Operation**: Beneficial in **hazardous jobs** like mining or chemical processing.

Ethical and Practical Concerns:

1. Privacy Risks:

- Neural data may contain **sensitive thoughts**, emotions, or intentions.
- Raises fears of **data misuse** and **mental surveillance**.

2. Digital Divide:

- Advanced BCIs are **expensive** and **technically complex**, risking **exclusion** of marginalized groups.

3. Mental Autonomy:

- Long-term BCI use could alter **brain function** or affect a person's **sense of agency**, leading to questions about **identity and autonomy**.

The Way Ahead:

- **Affordable Innovation**: Focus on developing **low-cost**, **scalable** BCI systems for widespread adoption.
- **Collaborative Ecosystem**: Foster **public-private partnerships** and **startup-driven solutions**.
- **Workforce Development**: Establish **education programs** and **certifications** to train specialists in BCI design, ethics, and deployment.

GS Paper 3 – Economic Development

Enhancing Competitiveness of MSMEs in India

Context: The **NITI Aayog**, in partnership with the **Institute for Competitiveness (IFC)**, has released a pivotal report aimed at strengthening the **Micro, Small, and Medium Enterprises (MSMEs)** sector in India—focusing on reforms to unlock its full potential.

About the Report:

- **Prepared By**: NITI Aayog & Institute for Competitiveness.
- **Objective**: To drive **systemic reforms** in **financing**, **skilling**, **innovation**, and **market access** to enhance MSME competitiveness.
- **Sectoral Focus**: Textiles, Chemicals, Automotive, Food Processing, among others.
- The report outlines **policy interventions** to improve India's position in the global value chain through **MSME transformation**.

India's MSME Sector at a Glance:

- Home to **5.93 crore registered MSMEs**, employing over **25 crore people**.
- In **2023–24**, MSME-related goods made up **45.73% of India's total exports**.
- Contribution to **Gross Value Added (GVA)** has steadily risen:
  - **27.3%** in 2020–21
  - **29.6%** in 2021–22
  - **30.1%** in 2022–23

Recent Policy Support:

- **Union Budget 2025–26** includes:
  - **Enhanced credit access**
  - Support for **first-time entrepreneurs**
  - Promotion of **labour-intensive industries**
- **Revised Classification Criteria**:
  - **Investment limits** increased by **2.5x**,
  - **Turnover limits** doubled -Aimed at boosting **scale**, **technology adoption**, and **job creation**.

Challenges Identified in the Report:

Financing Gaps:

- MSME access to formal credit rose (2020–24):
  - **Micro & Small**: From **14% to 20%**
  - **Medium**: From **4% to 9%**
- **Still**, about **81% of credit demand remains unmet**, with a funding gap of **80 lakh crore**.
- **CGTMSE (Credit Guarantee Fund)** has scaled up but still falls short in addressing deep credit deficits.

Skilling and Human Capital:

- Many MSME workers **lack formal training**, hindering **productivity**, **scalability**, and **quality standards**.

Innovation & Technology Adoption:

- **Low investment** in **R&D**, **product innovation**, and **quality certifications**.
- **Barriers** include:
    - High costs
    - Weak internet and electricity infrastructure
    - Lack of awareness of state tech-support schemes

Policy Awareness Deficit: Existing MSME policies suffer from **low awareness** and **ineffective implementation**, especially at the **state and district levels**.

Recommendations & Way Forward:

1. Targeted Interventions:

- Focus on **cluster-based** MSME development tailored to regional strengths (e.g., textiles in Tamil Nadu, food processing in Bihar).

2. Strengthening Market Access:

- Training in **digital marketing**
- Partnerships with **logistics and supply chain firms**
- Creation of **platforms for direct B2B and B2C linkages**, especially in the **Northeast and Eastern India**

3. State-Level Reforms:

- Develop **adaptive policy frameworks** that:
    - Promote **innovation**
    - Enhance **competitiveness**
    - Support **inclusive and green growth**

4. Institutional Collaboration:

- Stronger coordination between:
    - Central and state governments
    - Financial institutions
    - Academic and research bodies
    - Private sector partners

GS Paper 3 – Security

Terror Financing: A Global Security Threat

Context: India has intensified its crackdown on **terror financing**, urging global financial institutions such as the **IMF**, **World Bank**, and **ADB** to ensure that **developmental aid is not misused**—particularly in countries like **Pakistan**.
India also advocates for **Pakistan's re-listing on the FATF Grey List**, citing the need for **strict monitoring** of its financial ecosystem.

What is Terror Financing?

Terror financing refers to the **provision of funds**—from either **legitimate** or **illegitimate sources**—to support **terrorist individuals or organizations**. These funds are used to:

- Recruit operatives
- Procure weapons
- Plan and execute terror attacks
- Sustain organizational infrastructure

Major Sources of Terror Financing:

Source	Description
Hawala Transactions	Informal money transfer systems that evade formal banking channels, making funds hard to trace.
Fake Currency	Counterfeit notes circulated to destabilize economies and fund illegal activities.
Drug Trafficking	Illicit narcotics trade is a major source of income for terror outfits.
Extortion & Kidnappings	Hostage-taking and extortion from businesses/individuals for ransom.
Misused NGOs/Charities	Front organizations collect donations under false pretenses and redirect them to terror groups.

Challenges in Combating Terror Financing:

1. **Complex Financial Webs**: Use of shell companies, front businesses, and underground networks.
2. **Weak Global Coordination**: Poor intelligence sharing and uneven enforcement.
3. **Regulatory Gaps**: Disparity in laws and enforcement levels across jurisdictions.
4. **Technology Misuse**: Cryptocurrencies and encrypted payment platforms offer **anonymity**, making tracing difficult.

India's Multi-Pronged Response:

Legislative Framework:

- **Unlawful Activities (Prevention) Act (UAPA)**:
  - Allows designation of individuals/entities as **terrorists**.
  - Enables seizure of **assets and bank accounts**.
- **Prevention of Money Laundering Act (PMLA)**:

- Targets financial crimes and enables **confiscation of laundered property**.

Institutional Mechanisms:

- **Financial Intelligence Unit (FIU-IND)**: Tracks suspicious transactions and shares intelligence with agencies.
- **National Investigation Agency (NIA)**: Specializes in **counter-terrorism** investigations and financial linkages.

International Collaboration:

- Participation in the **Financial Action Task Force (FATF)**
- Hosting and joining platforms like **No Money for Terror (NMFT)** to build global consensus and enforcement mechanisms.

Technology Integration:

- **NATGRID (National Intelligence Grid)**: Integrates data from multiple sources for **real-time intelligence sharing**.

Data Analytics & AI tools to trace unusual transaction patterns and financial anomalies.

Way Forward:

- Strengthen **cross-border coordination** to shut down terror funding routes.
- Enhance **financial literacy and awareness** among law enforcement and banking institutions.
- Develop **robust regulation of cryptocurrencies and digital payment platforms**.
- Promote **public-private partnerships** for proactive threat identification and counteraction.

GS Paper 1 – Geography

Place in News: Chile

Context: A powerful **7.4 magnitude earthquake** recently struck **southern Chile**, prompting a **tsunami alert** across coastal regions. Chile, located in the **Pacific Ring of Fire**, frequently experiences intense **seismic activity**, including **earthquakes**, **volcanic eruptions**, and **tsunamis**.

Political and Geographical Overview:

Location:

Chile lies along the **western edge of South America**, stretching over 4,300 km from **north to south**, making it one of the longest countries in the world.

Boundaries:

- **North**: Bordered by **Peru** and **Bolivia**
- **East**: Shares its longest border with **Argentina**
    - The **Argentina–Chile border** is the **longest in South America** and the **third longest globally**, after:
        - **Canada–USA**
        - **Russia–Kazakhstan**
- **West**: Flanked by the vast **Pacific Ocean**

Geographical Highlights:

- **Andes Mountains** dominate the eastern spine of the country.
- **Atacama Desert** in the north is the **driest non-polar desert in the world**, receiving less than 1 mm of rain per year in some areas.
- Sits on the **Pacific Ring of Fire**, making it prone to:
    - **Volcanic eruptions**
    - **Earthquakes**
    - **Tsunamis**
- **Ojos del Salado**:
    - The **highest active volcano on Earth**, at **6,893 meters**
    - Also the **second-highest peak** in the Western Hemisphere

Economic Importance:

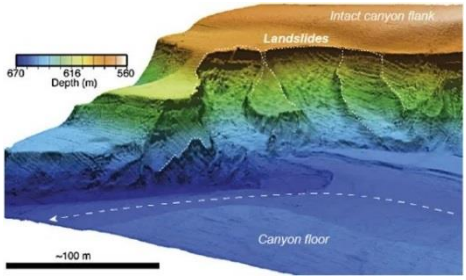
- **Chile is the world's largest producer of copper**, a vital metal for:
    - Electrical wiring
    - Electronics
    - Renewable energy infrastructure
- Located within the **"Lithium Triangle"** (with **Bolivia** and **Argentina**), containing:

- Over **50% of the world's lithium reserves**
- Crucial for **electric vehicle batteries** and **clean energy tec**

Did You Know?

- **Chile was the first South American country to join the OECD** (Organisation for Economic Co-operation and Development).
- The **Valparaíso region** is home to the oldest stock exchange in Latin America.
- Chile's **Naval Hydrographic and Oceanographic Service (SHOA)** plays a key role in monitoring Pacific tsunami threats.

Turbidity Currents in Submarine Canyons: A Deep-Sea Phenomenon



Context: Turbidity currents are **rapid, downslope flows of water** filled with **sediments**, making the water **denser** and less transparent. These currents behave similarly to **underwater avalanches**, often triggered by **geological disturbances** such as:

- **Earthquakes**
- **Submarine landslides**
- **Slope failures** and other geological events

These currents can travel great distances across the seafloor, shaping underwater landscapes and playing a vital role in oceanic processes.

Key Characteristics of Turbidity Currents:

Turbidity currents are an essential part of **deep-sea dynamics**. As the water's density increases due to suspended sediments, it becomes less transparent, often causing large-scale erosion of the seafloor. Key features include:

- **Erosion and Canyon Formation**: Turbidity currents actively carve out and **enlarge submarine canyons**, much like how rivers shape land canyons.
- **Layered Sediment Deposition**: These currents deposit sediments in **graded layers**, with **coarser particles** settling first, followed by **finer sediments**.
- **Shaping the Ocean Floor**: These flows contribute significantly to **deep-sea sedimentation**, sculpting the ocean's topography over time.

Submarine Canyons: Nature's Underwater Valleys:

Submarine canyons are **narrow, steep-sided valleys** that form on the **continental slopes** and rise. They can extend from the **continental shelf** down into the deep ocean, often carved by the erosive force of turbidity currents. Key aspects of submarine canyons include:

- **Global Presence**: There are approximately **9,477 known submarine canyons** globally, covering almost **11%** of the continental slope regions.
- **Distinct Morphology**: Canyons on **active margins** (tectonically active zones) are generally **steeper and shorter**, while those on **passive margins** (less tectonically active regions) tend to have more gradual slopes.
- **Unstable Walls**: The walls of these canyons are often **nearly vertical**, and their susceptibility to collapse adds further sediment to turbidity currents, increasing their destructive power.

Types of Submarine Canyons:

Submarine canyons come in different forms, each unique in its formation and function:

- **Bank Canyons**: These are **flat-topped** elevations along the continental margins, created through both **erosional** and **depositional** processes. A prominent example is **Dogger Bank** in the North Sea.

- **Shoal Canyons**: Shallow regions with accumulated sediments, typically found at depths of less than **10 meters** during low tide. These are often **hazardous to navigation**.
- **Reef Canyons**: Composed of **calcareous skeletons** from **corals and algae**, these reefs are biodiversity hotspots, particularly in the Pacific Ocean. They are commonly found associated with **guyots** and **seamounts**.

Microplastic Transport and Submarine Canyons:

A recent study published in *ACS Environmental Science & Technology* highlighted a groundbreaking discovery: **turbidity currents are now transporting microplastics** into the deep sea, particularly through submarine canyons. This occurs even in regions that aren't directly fed by rivers, such as the **Whittard Canyon** off the coast of Ireland. This finding underscores the growing environmental concerns of **plastic pollution** in deep-sea ecosystems and the role of submarine canyons as conduits for this pollution to reach even the most remote ocean depths.

Fun Fact: Submarine Canyons and Ecosystem Diversity

While submarine canyons are primarily known for their geological role, they are also critical **ecosystem hotspots**. The deep, nutrient-rich waters flowing through these canyons support diverse species of fish, **invertebrates**, and even **whale populations** that feed on abundant plankton and nutrients. Thus, submarine canyons serve not only as geologically dynamic structures but also as **biodiversity reservoirs** in the deep ocean.

In conclusion, **turbidity currents** and **submarine canyons** are key players in shaping the seafloor and influencing oceanic processes. They drive sedimentation, transport pollutants, and support marine ecosystems, making them critical to understanding the complex dynamics of our oceans.

GS Paper 3 – Environment and Ecology

Climate Change and the Shrinking Caspian Sea: A Looming Environmental Crisis

Context: The **Caspian Sea**, the world's **largest enclosed inland water body**, is now at the frontline of climate change impacts. Once a vast expanse sustaining economies, biodiversity, and regional geopolitics, this **tectonic lake** is rapidly shrinking—primarily due to **climate-driven evaporation**.

Alarming Water Level Declines:

Even with efforts to curb global warming, scientists project that the Caspian Sea will **drop by 5–10 meters** by the end of the century. If temperatures rise unchecked, this decline could reach up to **21 meters** by **2100**. The consequences of such a dramatic fall are profound and far-reaching.

Biodiversity on the Brink:

The shrinking waters place **endemic and endangered species** at risk:

- **Caspian Seal** (*Endangered* – IUCN): The only marine mammal native to the region.
- **Beluga Sturgeon** (*Critically Endangered*): Known for producing prized caviar, this ancient fish faces habitat destruction.

As salinity increases and shorelines recede, these species lose critical breeding and feeding grounds, accelerating their decline.

Economic and Industrial Fallout:

The Caspian region's economy—heavily reliant on **ports and hydrocarbon industries**—faces significant disruption:

- **Ports at Risk**: Major transport hubs like **Baku**, **Anzali**, **Aktau**, **Turkmenbashi**, and **Lagan** may become **inland relics**, severed from the sea.
- **Volga River Threat**: As the Caspian's **only maritime connection** to the outside world, a decline in the Volga's viability could **isolate the region's shipping network**.
- **Oil and Gas Production**: Key offshore fields such as **Kashagan (Kazakhstan)** and **Filanovsky (Russia)** are at risk of being **stranded**, jeopardizing **energy exports** and national revenues.

Public Health and Environmental Disaster:

As the seabed dries:

- **Toxic Dust Storms** may emerge, **releasing pollutants and salt** into the air—reminiscent of the **Aral Sea catastrophe**.
- **Communities** near the coast face increased risks of **respiratory illnesses**, soil degradation, and water insecurity.

Geopolitical and Environmental Significance:

The Caspian Sea is bordered by **five countries—Russia, Azerbaijan, Iran, Turkmenistan**, and **Kazakhstan**—and is fed primarily by three rivers: the **Volga**, **Ural**, and **Terek**.

- It serves as a **critical geopolitical hub**, providing transit routes, energy corridors, and biodiversity resources.
- The **retreat of its shoreline** could fuel **territorial disputes**, impact **fisheries**, and strain **regional cooperation**.

Did You Know?

- The Caspian Sea is **not a sea**, but a **lake**—formed in a **tectonic depression**, isolated from the world's oceans for millions of years.
- It's a **key wintering area for migratory birds**, supporting one of the most **unique brackish ecosystems** in the world.

Conclusion: A Call for Urgent Action

The **fate of the Caspian Sea** is a stark reminder of how climate change transcends land, sea, and borders. Protecting this unique water body requires **coordinated international action**, **adaptive water policies**, and **serious climate commitments**—before it becomes another **ecological tragedy** in the pages of history.