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# Weekly EXPECTED CURRENT AFFAIRS

for

## IAS EXAMINATION



From

06<sup>th</sup> April to 11<sup>th</sup> April 2026

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## 1.1. CUSTODIAL VIOLENCE AND POLICE ACCOUNTABILITY

### Context:

- **Recently**, a trial court in Madurai, Tamil Nadu, awarded the **death penalty** to nine policemen found guilty of the custodial torture and murder of a trader, P. Jayaraj, and his son, J. Benicks.
- The incident, which occurred in June 2020 at the Sattankulam police station, involved brutal physical assault during the COVID-19 lockdown. The judge categorized the act as a "social evil" and a "case of the fence eating the crop," emphasizing that law enforcement officers who are meant to protect the public had instead committed a heinous crime.
- This verdict has reignited the national debate on police accountability and the urgent need for anti-torture legislation in India.



### 1. Defining Custodial Violence

Custodial violence refers to the infliction of physical or mental suffering on individuals while they are in custody of the police or judicial authorities. It includes:

- **Physical Torture:** Beating, third-degree methods, and sexual assault.
- **Psychological Torture:** Threats, humiliation, and sleep deprivation.
- **Custodial Death:** Fatalities occurring in police lockups or prisons.

### 2. Constitutional Safeguards

The Indian Constitution provides several protections to prevent the abuse of power by the state:

- **Article 20(3):** Provides the right against **self-incrimination**, ensuring no person is compelled to be a witness against themselves.
- **Article 21:** Guarantees the **Right to Life and Personal Liberty**, which the Supreme Court has interpreted to include the right to be free from torture and cruel treatment.
- **Article 22:** Provides protection against arrest and detention, including the right to be informed of the grounds of arrest and the right to consult a legal practitioner.

### 3. Legal Provisions

- **Indian Penal Code (IPC) / Bharatiya Nyaya Sanhita (BNS):** Sections 330 and 331 of the IPC (now relevant sections in BNS) penalize the use of hurt or grievous hurt to extort confessions.
- **Code of Criminal Procedure (CrPC) / Bharatiya Nagarik Suraksha Sanhita (BNSS):** Section 176(1A) of the CrPC mandates a **judicial inquiry** (by a Magistrate) in cases of death, disappearance, or rape in custody.
- **Indian Evidence Act:** Section 25 states that a confession made to a police officer cannot be proved against an accused.

#### 4. Landmark Judicial Guidelines: D.K. Basu vs. State of West Bengal (1997)

The Supreme Court laid down 11 mandatory requirements for arrest and detention to prevent custodial torture:

- **Identification:** Police personnel must wear clear, visible name tags with designations.
- **Arrest Memo:** A memo must be prepared at the time of arrest, attested by at least one witness (family member or local respectable person).
- **Right to Inform:** The arrestee has the right to have a friend or relative informed of the arrest as soon as possible.
- **Medical Examination:** The arrestee should be examined at the time of arrest and every 48 hours during detention by a trained doctor.
- **Legal Access:** The arrestee may be permitted to meet their lawyer during interrogation (though not throughout).

#### 5. International Standards

- **United Nations Convention Against Torture (UNCAT):** India signed this convention in 1997 but has **not yet ratified** it. Ratification would require India to enact a specific standalone law criminalizing torture.

**Q. With reference to the safeguards against custodial violence in India, consider the following statements:**

1. Under the Bharatiya Nagarik Suraksha Sanhita (BNSS), a judicial inquiry is mandatory in every case of death in police custody.
2. India is a signatory to the United Nations Convention Against Torture (UNCAT) and has ratified it to implement its provisions into domestic law.
3. The D.K. Basu guidelines mandate that an arrestee must be medically examined by a doctor every 24 hours during their detention.

**How many of the statements given above are correct?**

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: (a)**

- **STATEMENT 1 IS CORRECT:** Section 176(1A) of the CrPC (carried forward in BNSS) mandates a judicial inquiry by a Metropolitan Magistrate or a Judicial Magistrate in cases of death, rape, or disappearance in custody.
- **STATEMENT 2 IS INCORRECT:** While India signed the UNCAT in 1997, it has **not** ratified it yet.
- **STATEMENT 3 IS INCORRECT:** The D.K. Basu guidelines state that the arrestee should be medically examined every **48 hours** during their detention, not 24 hours.

## 1.2. PM SURYA GHAR: MUFT BIJLI YOJANA

### Context:

Recently, the Ministry of New and Renewable Energy (MNRE) has proposed a new incentive scheme for States to accelerate the adoption of the "Utility-Led Aggregation (ULA)" model under the PM Surya Ghar: Muft Bijli Yojana. To achieve the national target of one crore rooftop solar households by March 2027, the government is encouraging State Power Distribution Companies (DISCOMs) to lead the installation process, particularly for households that face financial or infrastructural barriers.



### 1. Overview and Objectives

- **Launch:** Launched in February 2024 by the Prime Minister.
- **Nodal Ministry:** Ministry of New and Renewable Energy (MNRE).
- **Primary Goal:** To provide up to **300 units of free electricity** every month to one crore households across India.
- **Target Capacity:** Aiming to reach 30 GW of solar capacity through residential rooftop systems.
- **Financial Outlay:** A total central investment of over **₹75,021 crore**.

### 2. Implementation Models

The scheme moves beyond individual applications by introducing systemic models to ensure scalability:

- **Utility-Led Aggregation (ULA) Model:** DISCOMs or designated state agencies act as aggregators. They float bulk tenders to install systems across multiple households, lowering costs through economies of scale.
- **RESCO (Renewable Energy Service Company) Model:** A third-party developer (RESCO) installs, owns, and operates the solar plant on the consumer's roof. The consumer only pays for the electricity generated, often at a rate lower than the grid tariff.

### 3. Central Financial Assistance (CFA) & Subsidy Structure

The subsidy is directly credited to the consumer's bank account following installation and inspection.

- **For 1–2 kW systems:** Up to 60% of the benchmark cost.
- **For 2–3 kW systems:** 40% of the additional cost for the capacity beyond 2 kW.
- **Upper Limit:** The total subsidy is capped at a maximum of 3 kW capacity (approx. ₹78,000).
- **Low-Interest Loans:** Collateral-free, low-interest (around 7%) loan options are available through banks for systems up to 3 kW.

### 4. Special Components

- **Model Solar Village:** The scheme aims to develop one "Model Solar Village" in every district of India to act as a demonstration hub for solar adoption.

- **Local Body Incentives:** Urban Local Bodies (ULBs) and Panchayati Raj Institutions (PRIs) are provided financial incentives to promote and facilitate rooftop solar in their respective areas.
- **National Portal:** A dedicated digital platform handles the end-to-end process from registration to subsidy release, ensuring transparency.

**Q. With reference to the 'PM Surya Ghar: Muft Bijli Yojana', consider the following statements:**

1. The scheme provides a 100% subsidy for households installing rooftop solar systems up to 3 kW.
2. REC Limited has been designated as the National Programme Implementation Agency (NPIA) for the scheme.
3. Under the Utility-Led Aggregation (ULA) model, the ownership of the solar asset remains with the private developer for the entire life of the project.

**How many of the statements given above are correct?**

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: A**

- **STATEMENT 1 IS INCORRECT:** The scheme provides a subsidy of up to 60% for systems up to 2 kW and 40% for the additional capacity between 2 kW and 3 kW. It is not a 100% subsidy.
- **STATEMENT 2 IS CORRECT:** REC Limited is indeed the National Programme Implementation Agency (NPIA) responsible for coordinating the scheme across the country.
- **STATEMENT 3 IS INCORRECT:** In the ULA model, the utility (DISCOM) aggregates demand and facilitates installation, but ownership typically rests with the consumer or is transferred after a set period. Ownership remaining with a developer is a characteristic feature of the **RESCO model**, not necessarily the ULA model.

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# INTERNATIONAL RELATIONS

## 2.1. INDIA EXPRESSES 'DEEP CONCERN' OVER MASS CIVILIAN DEATHS IN LEBANON

### Context:

India formally expressed "**deep concern**" over the growing loss of civilian lives in Lebanon following **Israeli airstrikes** on **Beirut**, the Lebanese capital. Speaking at a press briefing at the **National Media Centre, New Delhi**, the Official Spokesperson of the **Ministry of External Affairs (MEA)**, **Randhir Jaiswal**, reiterated India's respect for "**sovereignty and territorial integrity**" of all states as "**essential**". The **Lebanese Health Ministry** reported the death toll rising to **1,223 people** — with over **357 injured** — within a single week. Israel struck targets in Beirut, claiming they were **command centres of Hezbollah**.



### India's Official Position on the Lebanon Conflict

- **Deep Concern:** India expressed serious concern over the large number of civilian casualties in Lebanon.
- **Sovereignty & Territorial Integrity:** India emphasised that respect for these principles within the international state system is essential — a consistent cornerstone of India's foreign policy.
- **Protection of Civilians:** India has always prioritised civilian protection as the foremost concern in conflict situations.
- **Indian Embassy in Beirut:** The MEA confirmed it remains in close contact with the Indian community in Lebanon.
- **Notable omission:** India stopped short of directly mentioning Israel by name in its statement.

## 2. About Lebanon

### 2.1 Geographic Profile

Parameter	Details
<b>Location</b>	Eastern Mediterranean coast; West Asia (Middle East)
<b>Borders</b>	Syria (north & east), Israel (south), Mediterranean Sea (west)
<b>Capital</b>	Beirut
<b>Area</b>	~10,452 sq km (one of the smallest countries in West Asia)
<b>Official Language</b>	Arabic (French also widely used)
<b>Currency</b>	Lebanese Pound (LBP)
<b>UN Membership</b>	Founding member of the United Nations (1945)

## 2.2 Political System — Confessionalism

Lebanon follows a unique political system called **confessionalism**, where state power is formally distributed along religious/sectarian lines:

- There are **18 officially recognised religious communities** in Lebanon.
- The **Taif Agreement (1989)** ended the Lebanese Civil War (1975–1990) and rebalanced power between Christians and Muslims.

## 2.3 Hezbollah

- **Hezbollah** ("Party of God") is a **Shia political party and militant organisation** founded in **1982** with **Iranian backing** following Israel's invasion of Lebanon.
- It operates a **state-within-a-state** in southern Lebanon and parts of Beirut — with its own army, hospitals, schools, and social services.
- Designated a **terrorist organisation** by the **USA, EU, Gulf Cooperation Council (GCC)**, and several Arab states.
- Lebanon's government has **not** designated Hezbollah as a terrorist organisation.
- Hezbollah has representation in the Lebanese Parliament and Cabinet.
- It fought a major war with Israel in **2006 (Second Lebanon War)**.
- Its long-time Secretary-General, **Hassan Nasrallah**, was killed by an Israeli airstrike in **2024**.

**Q. With reference to Lebanon's political system, consider the following statements:**

1. The Lebanese system of governance, known as confessionalism, distributes political power along religious lines.
2. The Taif Agreement of 1989 established the rule that the President of Lebanon must be a Sunni Muslim.
3. Lebanon officially recognises 18 religious communities.

**Which of the statements given above is/are correct?**

- (a) 1 only
- (b) 1 and 2 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Answer: A**

**Explanation:**

- **Statement 1 is correct** — confessionalism distributes power along religious lines.
- **Statement 2 is incorrect** — under the National Pact (1943) and Taif Agreement (1989), the President must be a **Maronite Christian**, the PM a **Sunni Muslim**, and Speaker a **Shia Muslim**.
- **Statement 3 is correct** — Lebanon recognises 18 religious communities.

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## 3.1. MONETARY POLICY COMMITTEE (MPC)

### Context:

- **Recently**, the Monetary Policy Committee (MPC) of the Reserve Bank of India (RBI), led by Governor **Sanjay Malhotra**, unanimously voted to keep the benchmark **Repo Rate** unchanged at **5.25%**.
- This decision comes in the wake of a temporary ceasefire in West Asia announced by the U.S. administration. Despite the easing of immediate hostilities, the RBI has adopted a cautious "wait and watch" approach, maintaining a **neutral stance** while factoring in supply-side shocks, elevated energy prices, and their subsequent impact on India's inflation and growth trajectory for the fiscal year 2026-27.



### 1. What is the Monetary Policy Committee?

The MPC is a statutory and institutionalized framework under the **Reserve Bank of India Act, 1934**, tasked with maintaining price stability while keeping in mind the objective of growth.

- **Origin:** It was established based on the recommendations of the **Urjit Patel Committee**.
- **Mandate:** The primary objective is to fix the benchmark policy rate (Repo Rate) to contain inflation within the specified target level (4% +\_ 2%).
- **Legal Provision:** Section 45ZB of the amended RBI Act, 1934.

### 2. Composition of the MPC

The committee consists of **six members**:

1. **Governor of the RBI** – Chairperson, ex officio.
2. **Deputy Governor of the RBI** in charge of monetary policy – Member, ex officio.
3. **One officer of the RBI** to be nominated by the Central Board – Member, ex officio.
4. **Three external members** appointed by the Central Government – Members (usually economists of international repute).

**Note for Prelims:** Each member has one vote. In case of a tie, the **Governor has a casting vote** (a second vote). The quorum for the meeting is four members.

### 3. Key Policy Tools and Terms

- **Repo Rate (Repurchasing Option):** The rate at which the RBI lends money to commercial banks against the collateral of government securities. It is the primary tool to control the money supply.
- **Neutral Stance:** This indicates that the RBI is flexible and can move the interest rates in either direction (increase or decrease) based on incoming data. It suggests that the current rates are neither stimulative nor restrictive.
- **Inflation Targeting:** The RBI uses **Consumer Price Index (CPI)** combined as the headline inflation measure for its targets.

#### 4. Current Macro-Economic Projections (April 2026)

Parameter	New Projection (FY27)	Reason for Change
<b>Real GDP Growth</b>	<b>6.9%</b> (Revised down from 7.6%)	Impact of West Asia conflict on energy/infra and supply shocks.
<b>CPI Inflation</b>	<b>4.6%</b> (Revised up from 4.4%)	Elevated crude oil prices (factored at \$85/barrel) and supply disruptions.
<b>Repo Rate</b>	<b>5.25%</b>	Neutral stance to balance growth-inflation trade-off.

#### Q. With reference to the Monetary Policy Committee (MPC), consider the following statements:

1. It is a statutory body constituted under the Banking Regulation Act, 1949.
2. The Governor of the Reserve Bank of India acts as the ex-officio Chairman of the committee.
3. A "Neutral Stance" in monetary policy implies that the RBI will strictly keep the repo rate unchanged for the next three quarters.
4. The decisions of the MPC are binding on the Reserve Bank of India.

#### How many of the above statements are correct?

- (a) Only one
- (b) Only two
- (c) Only three
- (d) All four

**Answer: B) Only two**

#### Solution:

- **STATEMENT 1 IS INCORRECT:** The MPC is a statutory body, but it was constituted under the **Reserve Bank of India Act, 1934** (specifically Section 45ZB), not the Banking Regulation Act.
- **STATEMENT 2 IS CORRECT:** The Governor of the RBI is indeed the ex-officio Chairperson of the MPC.
- **STATEMENT 3 IS INCORRECT:** A **Neutral Stance** does not mean rates will stay unchanged for a fixed period; it means the RBI has the **flexibility** to move rates in either direction (up or down) depending on the economic data.
- **STATEMENT 4 IS CORRECT:** Under the RBI Act, the policy rate decided by the MPC is binding on the Reserve Bank.

### 3.2. WORLD BANK'S INDIA GROWTH OUTLOOK (FY27)

#### Context

- The World Bank has revised India's real GDP growth forecast downward for the fiscal year **2026-27 (FY27)** to **6.6%**, down from an earlier projection of **7.2%**. This revision is primarily attributed to the spillover effects of the ongoing **conflict in West Asia (Middle East)** on global energy markets and domestic consumption.



#### 1. Major Factors Influencing Growth

##### A. Sectoral Trends

- **Industrial Slowdown:** Growth is expected to moderate to **7.5%**.

- **Resilient Sectors:** Manufacturing—specifically **electronics and automobiles**—is expected to prop up industrial growth.
- **Impacted Services:** Business services, food, and accommodation services are likely to be adversely affected by higher input costs (especially **LPG**) and the global slowdown.

### **B. External Risks & Vulnerabilities**

- **Energy Prices:** Extended disruptions in global **oil and gas** supply due to the Middle East conflict are expected to last until the end of 2026.
- **Remittances:** The Gulf economies account for nearly **38% of India's remittance inflows**. Labor market disruptions in this region could significantly lower these inflows, widening the **Current Account Deficit (CAD)**.
- **Export Demand:** Decreased demand from the Gulf region will weigh on overall industrial growth.

### **C. Domestic Challenges**

- **Inflation:** Persistently high global energy prices are expected to eventually lead to higher **retail inflation**, weighing on domestic demand.
- **Fiscal Consolidation:** Efforts to reduce the fiscal deficit could be reversed if the government increases subsidies or cuts excise rates to shield consumers from high energy prices.

## **2. Strategic Recommendations for Resilience**

- **Private Sector Growth:** Boosting private sector-led growth is deemed critical for strengthening economic resilience.
- **Workforce Entry:** Supporting more young people to enter the workforce is highlighted as a key priority.
- **Policy Buffers:** Maintaining energy-source diversification and robust policy buffers can provide some insulation from external shocks.

## **3. About World Bank**

The World Bank is an international financial institution that provides loans and grants to the governments of low- and middle-income countries for the purpose of pursuing capital projects.

- **Foundation:** Established in **1944** during the **Bretton Woods Conference** alongside the IMF.
- **Headquarters:** Washington, D.C., USA.
- **The World Bank Group:** It consists of five institutions:
  1. **IBRD:** International Bank for Reconstruction and Development.
  2. **IDA:** International Development Association.
  3. **IFC:** International Finance Corporation (Private sector arm).
  4. **MIGA:** Multilateral Investment Guarantee Agency.
  5. **ICSID:** International Centre for Settlement of Investment Disputes.
- Important Reports by World Bank
  - **World Development Report (WDR)**
  - **Global Economic Prospects (GEP)**
  - **Logistics Performance Index (LPI)**

**Q. With reference to India's growth outlook by the World Bank, consider the following statements:**

1. The downward revision in India's growth forecast is linked to global energy market disruptions.
2. Industrial growth is expected to decline mainly due to weak performance of the manufacturing sector.
3. Gulf countries play a significant role in India's remittance inflows.

Which of the statements given above are correct?

- (a) 1 and 3 only
- (b) 2 and 3 only
- (c) 1 only
- (d) 1, 2 and 3

**Answer: A**

**Explanation:**

**Statement 1 is Correct:** The World Bank revised India's growth forecast for FY27 downward to **6.6%** from 7.2%. This revision is primarily attributed to the spillover effects of the **conflict in West Asia (Middle East)**, which has caused significant disruptions in global **energy markets** (oil and gas).

**Statement 2 is Incorrect:** While industrial growth is expected to moderate to **7.5%**, the report specifically mentions that the **manufacturing sector**—particularly **electronics and automobiles**—is expected to be a **resilient** factor that will actually prop up industrial growth rather than weaken it. The slowdown is more linked to high input costs and a global cooling of demand.

**Statement 3 is Correct:** The Gulf economies are a vital source of foreign exchange for India, accounting for nearly **38% of India's total remittance inflows**. The report warns that any labor market disruption in this region could lower these inflows and widen India's **Current Account Deficit (CAD)**.

### 3.3. MSME SECTOR AND GLOBAL SUPPLY CHAIN DISRUPTIONS

**Context:**

**Recently**, the Union Government held high-level inter-ministerial meetings to address the escalating **compliance burden** and financial stress on **Micro, Small, and Medium Enterprises (MSMEs)** arising from the **West Asia crisis**. The disruption in maritime routes has led to shipments being rerouted or returned, triggering complex paperwork, regulatory uncertainties, and a "triple whammy" of logistics challenges for Indian exporters.



## 1. Nature of the Crisis

The conflict in West Asia (specifically affecting the Red Sea and Strait of Hormuz) has shifted the burden from mere logistics to heavy **regulatory compliance**. MSMEs, unlike large corporations, lack dedicated compliance teams and specialized software, making them vulnerable to:

- **Back-to-Town Procedure:** When a cargo is diverted back to India, it must undergo a specific customs procedure to return to the factory. This involves high warehousing costs and excludes the exporter from certain government benefits like the **RELIEF scheme**.
- **Rerouting Challenges:** If a shipping line drops cargo at an alternate port due to safety, the responsibility (and cost) of moving it to the final destination falls entirely on the exporter.
- **Tariff Quotas:** Many regions (e.g., Europe) have quarterly quotas for products like steel. Delays of even a few days can result in missing the quota window, forcing exporters to wait 90 days for the next cycle.

## 2. Key Government Interventions (2025-26)

- **RELIEF Scheme:** A dedicated financial support mechanism announced by the government to assist exporters specifically impacted by the West Asian crisis.
- **Credit Guarantee Scheme:** Plans for a **₹2.5 lakh crore** credit guarantee to ensure liquidity for businesses affected by war-induced disruptions.
- **Jan Vishwas 2.0 (2026):** Aimed at the **decriminalization** of minor technical and procedural lapses to reduce "compliance anxiety" for small businesses.

## 3. Significance of the MSME Sector

- **GDP Contribution:** Approximately **30%** of India's GDP.
- **Exports:** MSME-related products account for nearly **45%** of India's total exports.
- **Employment:** The second-largest employer after agriculture, providing livelihoods to over 11 crore people.
- **Udyam Portal:** The unified digital identity for MSMEs, which has seen over 7 crore registrations by early 2026.

## 4. Structural Challenges

- **The "Missing Middle":** A high concentration of micro-units but very few firms scaling up to become medium enterprises.
- **Digital Divide:** Over-reliance on fragmented systems (like basic spreadsheets) instead of integrated Enterprise Resource Planning (ERP) software.
- **Working Capital Stress:** Delayed payments and rising freight costs (which have surged by up to 10x on certain routes) have stretched the credit cycle from 40 days to nearly 120 days.

### Q. With reference to the MSME sector in India and recent global trade disruptions, consider the following statements:

1. The 'Back-to-Town' procedure refers to the customs process followed when an export cargo is returned to the domestic factory due to transit disruptions.
2. Under the current classification, a 'Medium' enterprise is defined as one where investment in plant and machinery does not exceed ₹50 crore and turnover does not exceed ₹250 crore.

3. The Jan Vishwas (Amendment of Provisions) Bill 2026 seeks to increase criminal penalties for technical lapses to ensure stricter compliance during global crises.

**Which of the statements given above is/are correct?**

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 only
- (d) 1, 2, and 3

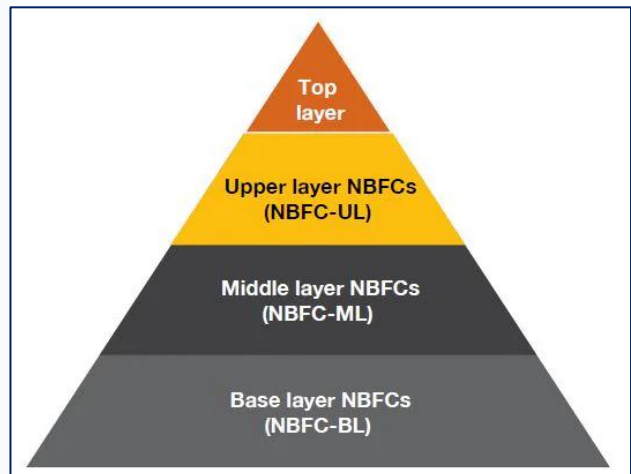
**Answer: A**

- **STATEMENT 1 CORRECT:** As per the recent trade logistics update, the back-to-town procedure is the regulatory path for returned export goods, often imposing a high compliance burden.
- **STATEMENT 2 CORRECT:** This aligns with the revised MSME classification (Investment < ₹50cr, Turnover < ₹250cr).
- **STATEMENT 3 INCORRECT:** The Jan Vishwas 2.0 (2026) actually aims to **decriminalize** minor offences to promote "Trust-Based Governance" and reduce compliance anxiety, rather than increasing penalties.

### 3.4. SCALE-BASED REGULATION (SBR) AND NBFC-UL FRAMEWORK

#### Context

- **Recently**, the Reserve Bank of India (RBI) issued a draft review of the "Scale Based Regulation" (SBR) to streamline the identification of **Upper Layer NBFCs (NBFC-UL)**. The RBI proposes to replace the current complex scoring methodology with a transparent, absolute asset-size threshold of **₹1,00,000 crore**.
- This change aims to provide regulatory clarity for large entities, including Core Investment Companies (CICs) and government-owned lenders, regarding their mandatory listing and enhanced capital requirements.



#### What is an NBFC?

A **Non-Banking Financial Company (NBFC)** is a financial institution registered under the **Companies Act, 1956/2013**, that provides banking services without meeting the legal definition of a bank.

- **Principal Business:** A company is classified as an NBFC if its financial assets constitute more than **50%** of its total assets, and its income from financial assets constitutes more than **50%** of its gross income (the **50-50 test**).
- **Key Distinctions from Banks:**
  - NBFCs **cannot accept demand deposits** (savings or current accounts).

- They do not form part of the **Payment and Settlement System**; hence, they cannot issue cheques drawn on themselves.
- The **Deposit Insurance and Credit Guarantee Corporation (DICGC)** facility is not available to NBFC depositors.
- **Regulation:** Primarily regulated by the RBI under the **RBI Act, 1934**. However, certain NBFCs like Insurance companies (IRDAI), Stock Broking (SEBI), and Nidhi companies (MCA) are regulated by other bodies.

### The Scale-Based Regulation (SBR) Framework

The SBR framework (effective since 2022) organizes NBFCs into four layers based on their size, activity, and risk.

Layer	Criteria & Composition
<b>Base Layer (NBFC-BL)</b>	Non-deposit taking NBFCs with assets < ₹1,000 crore; includes P2P platforms and Account Aggregators.
<b>Middle Layer (NBFC-ML)</b>	All <b>deposit-taking NBFCs</b> (regardless of size); Non-deposit NBFCs with assets ≥ ₹1,000 crore; HFCs and SPDs.
<b>Upper Layer (NBFC-UL)</b>	Identified by RBI as "systemically significant." Requires higher capital (CET-1) and mandatory listing.
<b>Top Layer (NBFC-TL)</b>	Remains empty by default; populated only if the RBI finds a specific NBFC-UL poses extreme systemic risk.

### Key Proposed Changes in the RBI Review

1. **Simplified Threshold:** Instead of the current "top 10" rule and parametric scoring, any NBFC with assets of **₹1 lakh crore and above** will automatically enter the Upper Layer.
2. **Inclusion of PSUs:** Government-owned NBFCs (like PFC and REC) will no longer be restricted to the Middle Layer. If they meet the asset size, they will face the same stringent regulations as private NBFC-ULs.
3. **Credit Risk Transfers:** NBFC-ULs can now use **State Government Guarantees** as risk mitigants without a cap, attracting a lower risk weight of **20%**, aligning them with bank-like standards.
4. **Mandatory Listing:** Entities identified as NBFC-UL are required to list on a stock exchange within **three years**. The new asset-based rule reinforces this requirement for large conglomerates and core investment companies (CICs) that exceed the ₹1 lakh crore mark

### Q. With reference to the Non-Banking Financial Companies (NBFCs) in India, consider the following statements:

1. An NBFC cannot accept demand deposits from the public.
2. Under the Scale-Based Regulation (SBR), all Housing Finance Companies (HFCs) are classified in the Base Layer.
3. The RBI has proposed an absolute asset-size threshold of ₹1 lakh crore for an NBFC to be classified in the Upper Layer.

**Which of the statements given above are correct?**

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2, and 3

**Answer: C**

**Solution:**

- **STATEMENT 1 IS CORRECT:** NBFCs are legally barred from accepting demand deposits (savings/current accounts); they can only accept term deposits if specifically authorized.
- **STATEMENT 2 IS INCORRECT:** Under the SBR framework, all Housing Finance Companies (HFCs) are placed in the **Middle Layer (NBFC-ML)**, not the Base Layer.
- **STATEMENT 3 IS CORRECT:** The 2026 RBI draft review proposes a transparent threshold of ₹1,00,000 crore (₹1 lakh crore) for identification in the Upper Layer.

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# ENVIRONMENT & GEOGRAPHY

## 4.1. GROUNDWATER MANAGEMENT AND REGULATION IN INDIA

### Context:

The **Public Accounts Committee (PAC)** recently presented its **41st report**, titled '**Ground Water Management and Regulation**,' in the Lok Sabha. The report highlights the alarming rate of groundwater depletion in India and the need for urgent regulatory intervention.



### 1. Key Findings: India's Global Footprint

- **Global Share:** India accounts for approximately **25% of global groundwater withdrawals**.
- **PAC Flagship:** The Public Accounts Committee has flagged this massive extraction rate as a critical concern for the country's water security.

### 2. Institutional Framework & Monitoring Networks

- **Central Ground Water Board (CGWB):** The apex central organization under the **Ministry of Jal Shakti** responsible for monitoring groundwater levels and quality.
  - The Central Ground Water Authority (CGWA) was constituted under Section 3 of the Environment (Protection) Act, 1986
- **Monitoring Infrastructure: National Network:** Approximately **27,000** stations for water level and **20,000** for water quality.
  - **Digital Integration:** Around **22,000 Digital Water Level Recorders (DWLRs)** with Telemetry transmit real-time data to central servers under the National Hydrology Project (NHP) and Atal Bhujal Yojana (ABY).
- **Jal Shakti Kendras (JSKs):** 712 district-level centers established as community hubs for knowledge dissemination and local dialogue on water issues.

### 3. Key Schemes and Initiatives

- **Jal Shakti Abhiyan (JSA):** An annual mission-mode campaign for water harvesting and artificial recharge. Over **2 Crore** works have been completed through convergence.
- **Jal Sanchay Jan Bhagidari (JSJB):** Launched in **2024** to turn rainwater harvesting into a mass movement; over **49 lakh** structures have been constructed.
- **National Aquifer Mapping & Management (NAQUIM):**
  - **Phase 1.0:** Completed mapping of the entire mappable area (**25 lakh sq. km**).
  - **Phase 2.0:** Focuses on high-resolution data for priority areas using state-of-the-art technologies.
- **Atal Bhujal Yojana (ABY):** A unique, community-led participatory scheme implemented in **8,203 water-stressed Gram Panchayats** across 7 states (Gujarat, Haryana, Karnataka, MP, Maharashtra, Rajasthan, and UP).

- **Mission Amrit Sarovar:** Aimed at developing/rejuvenating **75 water bodies per district**.

#### 4. Regulatory & Legal Framework

- **Constitutional Status:** 'Water' is a **State subject**.
- **Model Groundwater Bill:** Drafted by the Centre to provide a framework for states to curb indiscriminate extraction and mandate rainwater harvesting. **21 States/UTs** have adopted it so far.
- **Central Ground Water Authority (CGWA):** Established for central-level regulation. It issues **No Objection Certificates (NOCs)** for industrial, infrastructure, and mining extraction in 19 States/UTs.
  - **Penalty Mechanism:** Environmental Compensation (EC) charges and penalties are imposed for unlawful extraction.

#### Q. With reference to groundwater management and regulation in India, consider the following statements:

1. India accounts for nearly one-fourth of the global groundwater withdrawals.
2. The Central Ground Water Authority (CGWA) has been constituted under the Water (Prevention and Control of Pollution) Act, 1974.
3. The Atal Bhujal Yojana is a community-led participatory scheme implemented in selected water-stressed Gram Panchayats.
4. Water is listed as a subject in the Union List of the Constitution of India.

#### Which of the statements given above are correct?

- (a) 1 and 3 only
- (b) 2 and 4 only
- (c) 1, 2 and 3 only
- (d) 1, 3 and 4 only

**Answer: A**

#### Explanation

**Statement 1 is Correct:** India accounts for about **25% of global groundwater withdrawals**, making it the largest user globally.

**Statement 2 is Incorrect:** The **Central Ground Water Authority (CGWA)** is constituted under **Section 3 of the Environment (Protection) Act, 1986**, not under the Water (Prevention and Control of Pollution) Act, 1974.

**Statement 3 is Correct:** The **Atal Bhujal Yojana (ABY)** is a **community-led participatory scheme** implemented in water-stressed Gram Panchayats across selected states.

**Statement 4 is Incorrect:** **Water is a State subject** under the Constitution of India (State List), not in the Union List.

## 4.2. INDIA-BANGLADESH BORDER MANAGEMENT: EXPLORING "BIOTIC BARRIERS"

### Context

**Recently**, the Border Security Force (BSF) has been directed to explore the feasibility of deploying predatory reptiles, such as **crocodiles and snakes**, to patrol the riverine gaps along the India-Bangladesh border. This directive, reportedly in line with instructions from the Union Home Ministry, aims to create a "biological deterrent" in areas where traditional physical fencing is impossible due to the difficult topography, frequent flooding, and shifting river courses.



### 1. The Geography of the India-Bangladesh Border

- **Length:** India shares its longest international land border with Bangladesh, stretching **4,096.7 km**.
- **States Involved:** West Bengal, Assam, Meghalaya, Tripura, and Mizoram.
- **Riverine Gaps:** Approximately **175 km to 371 km** (depending on seasonal flooding) consists of riverine stretches and marshy terrain (e.g., the Brahmaputra in Assam and the Ichamati in West Bengal).
- **The "Porous" Nature:** Unlike the desert or mountain borders, this boundary passes through densely populated villages, paddy fields, and rivers, making it one of the most complex borders to manage globally.

### 2. Security Challenges

- **Infiltration & Illegal Migration:** Porous riverine gaps are frequently used for illegal crossing.
- **Transnational Crime:** Smuggling of cattle, narcotics (like Phensedyl), and Fake Indian Currency Notes (FICN) is rampant.
- **Anti-National Activities:** The border serves as a conduit for insurgent groups in the Northeast to find safe havens.

### 3. Current Border Infrastructure Status

- **Physical Fencing:** Of the total sanctioned length, approximately **3,326 km** has been approved for fencing, with roughly **2,954 km** completed as of 2024-25 records.
- **Floodlights:** To curb nighttime activities, the government has sanctioned phase-wise installation of floodlights along the border.
- **Technological Solutions (CIBMS):** In areas where fencing is not feasible, the **Comprehensive Integrated Border Management System (CIBMS)** is deployed. This includes:
  - Thermal imagers and infrared sensors.
  - Underground and underwater sensors.
  - Drones and high-resolution cameras.

#### 4. The Proposal: "Biotic Patrols"

The internal communication within the BSF suggests exploring "**biological barriers**":

- **The Rationale:** Crocodiles in the water and venomous snakes in marshy bushes could act as a psychological and physical deterrent to illegal crossers.
- **Challenges Identified:**
  - **Human-Wildlife Conflict:** The border is densely populated; reptiles do not distinguish between a smuggler and a local villager.
  - **Ethical & Ecological Concerns:** Introducing or augmenting predator populations can disrupt local ecosystems.
  - **Procurement & Control:** Managing wildlife behavior in an open, flowing river system is practically impossible compared to "moats" used in ancient forts.

**Q. With reference to the India-Bangladesh border management, consider the following statements:**

1. The India-Bangladesh border is the longest land border shared by India with any neighboring country.
2. The Comprehensive Integrated Border Management System (CIBMS) is exclusively used for areas where physical fencing is already completed to provide a second layer of security.
3. The Border Security Force (BSF) is the primary agency responsible for guarding this international boundary.

**Which of the statements given above are correct?**

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2, and 3

**Answer: C**

- **STATEMENT 1 IS CORRECT:** India shares a 4,096.7 km border with Bangladesh, which is its longest land frontier.
- **STATEMENT 2 IS INCORRECT:** CIBMS (incorporating sensors, drones, and cameras) is specifically designed to provide "technological solutions" or "non-physical barriers" in difficult terrains like riverine gaps where physical fencing is **not** feasible.
- **STATEMENT 3 IS CORRECT:** The BSF is the designated "Border Guarding Force" for the borders with Pakistan and Bangladesh.

### 4.3. WHY BIRDS MOVE: THE ENERGY EFFICIENCY HYPOTHESIS

#### Context

**Recently**, a groundbreaking study published in the journal *Science Advances* has challenged long-standing beliefs about why birds move up and down mountains. While it was previously assumed that birds migrate primarily to "track" specific temperatures they are adapted to, researchers from the University of East Anglia (UK) and other global institutions have found that **energy efficiency**—the optimization of food intake against energy expenditure—is the true driver of seasonal mountain migration.



#### 1. What is Elevational Migration?

Elevational (or altitudinal) migration refers to the seasonal movement of animals, particularly birds, up and down mountain slopes.

- **Summer:** Birds typically move to higher elevations to exploit seasonal flushes of food (insects/fruits) and find breeding grounds.
- **Winter:** They descend to lower, more productive elevations to escape harsh conditions and resource scarcity at the summits.

#### 2. The New Paradigm: Energy Efficiency vs. Temperature

- **Traditional View:** Birds are "climate trackers" who stay within a narrow temperature range (thermal niche) to which they are evolutionarily adapted.
- **The New Finding:** The study analyzed **34 mountain regions** and nearly **11,000 avian populations**. It revealed that many birds move **against the temperature gradient** (moving into cooler areas during winter) if that is where resources are most abundant.
- **Core Driver:** The movement is a strategic choice to optimize their **energy budget**. Birds prioritize areas with high food availability and low competition from other species, even if the temperature is not "ideal."

#### 3. The SEDS Model (Seasonally Explicit Distributions Simulator)

Researchers utilized the **SEDS model** to simulate how birds *should* be distributed if they were perfectly optimizing their energy.

- The model starts with an "empty mountain" and adds bird populations one by one based on where they can find the most food with the least effort.
- The simulation matched real-world bird distribution patterns in **28 out of 34** mountain ranges studied, confirming that energy optimization is a global biological pattern.

#### 4. Case Study: The Yellow-billed Chough (Alpine Chough)

- **Scientific Name:** *Pyrrhocorax graculus*.
- **Habitat:** High-altitude specialist found in the Himalayas (including North Sikkim), Alps, and Central Asia.

- **Specialty:** It is known to nest at higher altitudes than almost any other bird (up to 6,500m).
- **Dietary Shift:** In summer, they feed on invertebrates at high elevations; in winter, they shift to fruits or human-provided food at lower elevations/tourist sites to maintain their energy balance.
- **IUCN Status: Least Concern.**

### Conservation and Climate Change Implications

- **Habitat Management:** Understanding that birds follow "resources" rather than just "cold air" helps conservationists protect specific foraging corridors.
- **Agricultural Impact:** Changes in land use (like farming at mid-elevations) can disrupt the energy budgets of migrating birds by altering food availability.
- **Climate Predictions:** The study predicts an average **upslope shift of ~129 meters** by the year 2100 due to climate change, not just because of heat, but because primary productivity (plants and insects) will shift higher.

### Q. With reference to the 'Elevational Migration' of birds, consider the following statements:

1. It involves the seasonal movement of birds between different latitudes, such as the migration of the Arctic Tern.
2. The "Energy Efficiency" hypothesis suggests that birds move primarily to optimize their food intake and energy expenditure rather than simply tracking temperatures.
3. The Yellow-billed Cough, a common high-altitude resident of the Himalayas, is listed as 'Critically Endangered' on the IUCN Red List.

### Which of the statements given above is/are correct?

- (a) 1 and 2 only
- (b) 2 only
- (c) 1 and 3 only
- (d) 2 and 3 only

### Solution:

### Answer: (b)

- **STATEMENT 1 IS INCORRECT:** Seasonal movement between latitudes is called **Latitudinal Migration**. Elevational migration specifically refers to movement up and down **mountain slopes**.
- **STATEMENT 2 IS CORRECT:** As per the latest research, birds migrate to optimize their energy budgets (balancing food availability and competition) rather than just staying in a specific temperature zone.
- **STATEMENT 3 IS INCORRECT:** The Yellow-billed Cough (*Pyrrhocorax graculus*) is listed as '**Least Concern**' on the IUCN Red List, as it is widespread and abundant across several mountain ranges.

#### 4.4. HECTOCOTYLUS: THE SENSORY INNOVATION IN CEPHALOPODS

##### Context:

Recent scientific research has redefined our understanding of the **hectocotylus**, a specialized arm in male octopuses. Previously regarded solely as a reproductive tool for sperm delivery, it is now recognized as a sophisticated **sensory organ** capable of "tasting" and identifying mates through chemical detection, even in complete darkness.



##### 1. Functional Evolution: From Delivery to Detection

- **Traditional Understanding:** Historically, scientists viewed the hectocotylus primarily as a mechanical appendage used to transfer spermatophores (sperm packets) into the female's mantle cavity.
- **The New Discovery:** Research indicates that the arm functions as a **chemosensory organ**. It allows the male to detect **progesterone**, a hormone present in the female's skin and reproductive tract.
- **Mechanism:** By physically touching the female, the male "tastes" the hormonal signals. This sensory assessment ensures reproductive success during the rare and brief encounters between solitary octopuses.

##### 2. The Role of CRT1 Receptors

- **The CRT1 Receptor:** Scientists have identified a specific receptor called **CRT1** that triggers mating behavior.
- **Evolutionary Origin:** CRT1 evolved from ancient neurotransmitter receptors.
- **Dual Functionality:**
  - 1. **Predation:** Similar receptors are used by octopuses to hunt prey by sensing chemicals on the seafloor.
  - 2. **Reproduction:** Over millions of years, CRT1 specialized to recognize progesterone with high affinity, facilitating mate identification.

##### 3. Biological and Evolutionary Significance

- **Efficiency in Darkness:** The ability to sense hormones through touch allows cephalopods to locate the female oviduct for insemination in the deep sea or nocturnal environments where visual cues are absent.
- **Integrated Appendage:** The hectocotylus represents a "merged" evolutionary innovation, combining **sensory assessment** and **gamete delivery** into a single limb.
- **Biodiversity:** This discovery highlights how minute changes in **protein structures** (like the CRT1 receptor) can lead to complex new behaviors and drive the vast biodiversity found in marine ecosystems.

**Q. With reference to the hectocotylus in octopuses, consider the following statements:**

1. The hectocotylus contains receptors such as CRT1 that help in detecting chemical signals from females.
2. The CRT1 receptor is exclusively used for reproduction and has no role in other biological functions.

**Which of the statements given above is/are correct?**

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

**Correct answer: (a) 1 only**

Explanation:

**Statement 1 is Correct:** The **hectocotylus** (a specialized arm in male octopuses used for reproduction) contains **chemoreceptors**, including proteins like **CRT1**, which help detect **chemical signals released by females**. This plays a key role in mate recognition and reproductive behavior.

**Statement 2 is Incorrect:** The claim that **CRT1 receptor is exclusively used for reproduction** is too absolute. In biology, receptors (even if primarily associated with reproduction) often have **broader or overlapping roles**, such as general chemosensory functions. Hence, saying it has *no role in other biological functions* is incorrect.

#### 4.5. SAND MINING REGULATIONS AND GOVERNANCE

##### Context

- **Recently**, the Supreme Court's scrutiny of illegal mining in the National Chambal Sanctuary has brought the spotlight back to the "Sand Mafia" and the collapse of riverine governance. While sand is essential for the construction boom in North India, its extraction has moved from a regulated activity to an organized crime, threatening the structural integrity of bridges and the survival of aquatic species.



##### 1. Legal Status: A "Minor Mineral"

In India, minerals are classified into 'Major' and 'Minor' under the **Mines and Minerals (Development and Regulation) Act, 1957 (MMDR Act)**.

- **Minor Mineral:** Sand is classified as a minor mineral.

- **Regulatory Authority:** Unlike major minerals (where the Union has significant control), the **State Governments** have the power to frame rules for the grant of concessions, fixing royalty rates, and monitoring minor minerals.
- **Constitutional Link:** This falls under the **State List (List II)** of the Seventh Schedule, though the Union can provide a broad framework for conservation.

## 2. Ecological and Physical Impact

Unregulated or "instream" sand mining causes irreversible damage to river systems:

- **Riverbed Incision:** Excessive mining lowers the riverbed, leading to bank erosion and the deepening of the river channel.
- **Loss of Biodiversity:** As seen in the Chambal region, mining destroys the sandbars required by **Gharials and Turtles** for nesting.
- **Water Quality:** Increased turbidity (muddiness) affects the penetration of sunlight, harming aquatic plants and fish.
- **Infrastructure Risk:** By lowering the water table and eroding banks, mining can undermine the foundations of **bridges and piers**.

## 3. Regulatory Framework: Guidelines & Monitoring

To balance development with ecology, the MoEF&CC issued two key documents:

- **Sustainable Sand Mining Management Guidelines (SSMG) 2016:** Focused on the "District Survey Report" (DSR) to identify areas where mining is sustainable. It emphasizes that the amount of sand extracted should not exceed the annual rate of replenishment.
- **Enforcement & Monitoring Guidelines 2020:** Introduced technical tools like **Drones, GPS tracking of vehicles, and Night Vision Surveillance** to prevent illegal extraction. It also mandated "Replenishment Studies" to be conducted before renewing mining leases.

## 4. Environmental Clearance (EC)

Following the Supreme Court's judgment in the **Deepak Kumar vs. State of Haryana (2012)** case:

- **Mandatory EC:** Environmental clearance is mandatory for mining minor minerals even in areas **less than 5 hectares**.
- **Categorization:** Large projects (Category A) require clearance from the Central Government (MoEF&CC), while smaller projects (Category B) are cleared by the **State Environment Impact Assessment Authority (SEIAA)**.

### Q. With reference to the management of sand mining in India, consider the following statements:

1. The power to frame rules to prevent illegal mining of minor minerals is vested entirely in the State Governments.
2. The "Sustainable Sand Mining Management Guidelines" mandate that sand extraction can only be permitted after a replenishment study proves the sustainability of the resource.
3. According to the 2012 Supreme Court ruling, environmental clearance is not required for mining leases involving an area of less than five hectares.

**How many of the statements given above are correct?**

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Solution:**

**Answer: (b)**

- **STATEMENT 1 IS CORRECT:** Section 23C of the MMDR Act, 1957, empowers State Governments to frame rules to prevent illegal mining, transportation, and storage of minerals.
- **STATEMENT 2 IS CORRECT:** Both the 2016 and 2020 guidelines emphasize that mining must be based on a District Survey Report and replenishment data to ensure the river's health.
- **STATEMENT 3 IS INCORRECT:** In the *Deepak Kumar Case (2012)*, the Supreme Court made it mandatory to obtain Environmental Clearance even for lease areas **less than five hectares**.

#### 4.6. WETLAND CONSERVATION AND ENVIRONMENTAL GOVERNANCE

**Context**

- **Recently**, the National Green Tribunal (NGT) ruled that the National Highway Authority of India (NHAI) violated environmental regulations during the construction of the **Urban Extension Road-II (UER-II)** in Delhi. The tribunal found that the NHAI encroached upon a protected wetland in **Goyla Khurd village** by constructing permanent concrete pillars within the water body.
- This violation came to light through a media report, prompting the NGT to take *suo motu* cognizance of the 80% disappearance of the pond. The court has now directed the Ministry of Environment, Forest and Climate Change (MoEF&CC) to review the environmental clearance granted to the project and take corrective measures within six months.



#### 1. The Wetlands (Conservation and Management) Rules, 2017

Wetlands are often called the "kidneys of the landscape" due to their water purification abilities. In India, they are protected under these specific rules:

- **Prohibited Activities (Rule 4):** The rules strictly prohibit any reclamation of wetlands or the construction of any permanent structures on them.
- **Definition:** Wetlands include areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary.
- **State Wetland Authority:** The 2017 rules decentralized power, making State/UT Wetland Authorities responsible for identifying and notifying wetlands in their jurisdiction.
- **Digital Inventory:** Authorities are required to maintain a digital inventory of all wetlands to prevent encroachment.

## 2. Environmental Impact Assessment (EIA)

The EIA is a statutory process under the **Environment Protection Act, 1986**, used to evaluate the likely environmental impacts of a proposed project.

- **Transparency:** Project proponents (like NHAI) must disclose all potential impacts, such as construction within water bodies.
- **The Violation:** In the Urban Extension Road-II (UER-II) case, the NGT noted that NHAI failed to disclose the construction of pillars within the pond during the clearance process, leading to a lack of proper impact assessment by the MoEF&CC.

## 3. National Green Tribunal (NGT)

Established under the **NGT Act, 2010**, it is a specialized body for the effective disposal of environmental cases.

- **Suo Motu Power:** As affirmed by the Supreme Court, the NGT has the power to take up cases on its own (without a formal complaint) based on media reports or other information.
- **Composition:** It consists of a Chairperson (Judicial Member) and both Judicial and Expert Members to ensure technical accuracy in judgments.
- **Mandate:** It must endeavor to dispose of cases within **6 months** of filing.
- **Principles of natural justice:** The Tribunal shall not be bound by the procedure laid down under the Code of Civil Procedure, 1908, and 1908 or the Indian Evidence Act, 1872 but shall be guided by principles of natural justice.
- **Key Environmental Laws Handled by NGT:**
  - The Water (Prevention and Control of Pollution) Act, 1974,
  - The Water (Prevention and Control of Pollution) Cess Act, 1977,
  - The Forest (Conservation) Act, 1980,
  - The Air (Prevention and Control of Pollution) Act, 1981,
  - The Environment (Protection) Act, 1986,
  - The Public Liability Insurance Act, 1991 and
  - The Biological Diversity Act, 2002.

## 4. Urban Wetlands: Challenges and Importance

Urban wetlands like the one in Goyla Khurd are critical for:

- **Groundwater Recharge:** Essential for cities like Delhi facing water scarcity.
- **Flood Mitigation:** Acting as sponges during heavy monsoon rains.
- **Biodiversity:** Supporting local flora and avian species.

### Q. With reference to the protection of wetlands and environmental governance in India, consider the following statements:

1. Under the Wetlands (Conservation and Management) Rules, 2017, the Central Government has the primary responsibility for identifying and notifying all local wetlands.
2. The National Green Tribunal (NGT) is an autonomous body that lacks the power of *suo motu* cognizance, requiring a formal petition to initiate proceedings.
3. The Environment Impact Assessment (EIA) is a mandatory process for large-scale highway projects under the Environment Protection Act, 1986.

**How many of the statements given above are correct?**

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Solution:**

**Answer: (a)**

- **STATEMENT 1 IS INCORRECT:** Under the 2017 Rules, this power is decentralized to the **State/UT Wetland Authorities**. The Central National Wetland Committee plays an advisory role.
- **STATEMENT 2 IS INCORRECT:** The NGT **possesses suo motu powers**, allowing it to initiate cases on its own motion to protect the environment.
- **STATEMENT 3 IS CORRECT:** Highway projects (Category A or B depending on length/expansion) require mandatory **Environmental Clearance** based on an EIA report.

#### 4.7. COMPTROLLER AND AUDITOR GENERAL OF INDIA (CAG) & LAKE CONSERVATION

**Context:**

**Recently**, a report by the Comptroller and Auditor General of India (CAG) titled 'Conservation and Management of Lakes' revealed that out of 697 lakes in Jammu and Kashmir, 518 have either vanished or significantly shrunk as of March 2022.

The report highlights that 315 lakes have completely disappeared due to human activities, siltation, and land-use changes, leading to an increased risk of

extreme weather events like the 2014 floods. It pointed out that various government departments failed to carry out detailed surveys or formulate comprehensive management programs for these critical water bodies.



##### 1. The Institution of CAG

The CAG is an independent authority under the Constitution of India, acting as the guardian of the public purse and a key pillar of democratic accountability.

- **Constitutional Provisions: Article 148** provides for an independent office of the CAG, appointed by the President by warrant under his hand and seal.
- **Tenure and Removal:** The CAG holds office for a period of **6 years or up to the age of 65 years**, whichever is earlier, and can be removed only on grounds of "proved misbehaviour or incapacity" in a manner similar to a Judge of the Supreme Court.
- **Duties (Article 149):** The CAG audits all receipts and expenditures of the Union and the States, including bodies substantially financed from the Consolidated Fund.

- **Performance Audit:** Unlike a regular financial audit, the CAG also conducts "Performance Audits" to assess whether government programs (like the Lake Conservation in J&K) have achieved their objectives with economy, efficiency, and effectiveness.

## 2. Ecological Significance of Lakes

Lakes and wetlands are vital components of the hydrological cycle and provide several ecosystem services:

- **Flood Regulation:** They act as natural sponges and "flood balancing reservoirs" by absorbing excess runoff during heavy rainfall.
- **Groundwater Recharge:** They facilitate the percolation of water into the subsurface aquifers.
- **Biodiversity:** They serve as habitats for diverse aquatic flora and fauna and migratory birds.

## 3. Key Issues in J&K Lake Management

The CAG report identifies specific administrative failures:

- **Lack of Baseline Data:** No detailed physical, chemical, or biological surveys were conducted for 697 lakes, preventing the creation of effective development plans.
- **Anthropogenic Pressure:** Unregulated construction and land-use changes have led to the loss of open water areas.
- **Limited Coverage:** Management programs were active for only six major lakes (Dal, Wular, Hokersar, Manasbal, Surinsar, and Mansar), leaving hundreds of smaller high-altitude lakes vulnerable.

### Major Lakes in Jammu & Kashmir (J&K)

Lakes in this region are primarily freshwater and often formed by tectonic activity or the meandering of rivers.

- **Wular Lake:** Located in the Bandipora district, it is **one of the largest freshwater lakes in Asia**. It was formed due to tectonic activity and is fed by the **Jhelum River**. It is a designated **Ramsar Site**.
- **Dal Lake:** Known as the "Jewel in the Crown of Kashmir," this post-glacial lake in Srinagar is famous for its houseboats and "Shikaras." It is currently being integrated into a protective wetland framework. **Char Chinar, also known as Rupa Lank or Silver Island**, is the most famous island located in the middle of Dal Lake.
- **Manasbal Lake:** Located in the Ganderbal district, it is considered the **deepest lake in India**. It is famous for the growth of lotus (*Nelumbo nucifera*) during the summer.
- **Nigeen Lake:** Often considered an extension of Dal Lake, it is a mildly eutrophic lake connected to the Dal via a narrow strait.
- **Surinsar and Mansar Lakes:** These are twin lakes located in the Jammu region. They are designated as a single **Ramsar Site** due to their ecological importance and spiritual significance.
- **Hokersar (Hokera) Wetland:** A critical bird sanctuary and Ramsar site near Srinagar, acting as a major stopover for migratory birds from Central Asia and Siberia.

### Major Lakes in Ladakh

Ladakh is characterized by high-altitude, endorheic (closed) basins. Many of these lakes are saline because water evaporates without an outlet, leaving minerals behind.

- **Pangong Tso:** A long, narrow, endorheic saline lake situated at an altitude of about 4,350m. It gained global attention due to its proximity to the Line of Actual Control (LAC). About 60% of its length lies in China.
- **Tso Moriri (Mountain Lake):** This is the **largest high-altitude lake entirely within India**. It is a **Ramsar Site** and supports unique biodiversity, including the **bar-headed goose and the black-necked crane**.
- **Tso Kar (White Lake):** Known as the "White Lake" due to the white salt efflorescence on its margins. It is part of the **Tso Kar Wetland Complex**, which was added as India's 42nd **Ramsar Site**.

**Kyagar Tso:** A small, brackish-saline lake located in the Rupshu Valley, identifiable by its distinct turquoise color.

### Q. With reference to the Comptroller and Auditor General (CAG) of India and environmental auditing, consider the following statements:

1. The CAG derives its audit mandate from Article 149 of the Constitution of India and the CAG's (DPC) Act, 1971.
2. Performance audits conducted by the CAG are restricted only to the financial records of the Union government and do not extend to state-level environmental projects.
3. The CAG submits its audit reports relating to the accounts of a State to the Governor, who causes them to be laid before the State Legislature.

### How many of the statements given above are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

### Solution:

### Answer: (b)

- **STATEMENT 1 IS CORRECT:** The CAG's duties and powers regarding the audit of accounts are prescribed under Article 149 and the Duties, Powers and Conditions of Service (DPC) Act, 1971.
- **STATEMENT 2 IS INCORRECT:** Performance audits are a core function of the CAG and extend to both Union and State government programs, including environmental conservation schemes like the one mentioned in the J&K report.
- **STATEMENT 3 IS CORRECT:** According to Article 151, the reports of the CAG relating to the accounts of a State are submitted to the Governor, who then places them before the State Legislature.

## 4.8. BAUXITE MINING AND TRIBAL RIGHTS

### Context

**Recently**, violent clashes broke out in Odisha's Rayagada district as local tribal communities protested against the construction of a road leading to the proposed Sijimali bauxite mine. The residents of Kutamal village expressed deep concerns that the mining project, estimated to hold 311 million tones of bauxite, would deplete perennial water sources and severely impact their traditional livelihoods.



This incident highlights the ongoing tension between industrial development by companies like Vedanta Limited and the protection of tribal rights under the constitutional framework.

### 1. Bauxite: The Ore of Aluminum

- **Composition:** Bauxite is not a specific mineral, but a rock consisting mainly of hydrated aluminum oxides.
- **Geological Formation:** It is formed by the decomposition of a wide variety of rocks rich in aluminum silicates under tropical and sub-tropical conditions (lateralization process).
- **Usage:** It is the primary ore used to produce Alumina, which is then smelted to create Aluminum—a critical metal for the aerospace, construction, and packaging industries.

### 2. Bauxite Distribution in India

- India is home to significant bauxite reserves, estimated at approximately **650 million tonnes** as of 2026. Production is dominated by a few key states, with the **Eastern Ghats** being the most productive region.

#### a. Odisha (The Leader)

- **Share:** Produces over **50%** of India's total output.
- **Key Belts:** The 300-km-long belt across **Kalahandi and Koraput** is the largest bauxite-bearing region in the country.
- **Major Mines: Panchpatmali (Koraput):** Often cited as Asia's largest bauxite mine; it supplies the NALCO refinery at Damanjodi.
  - **Gandhamardan (Bargarh):** A high-grade deposit of strategic importance.
  - **Kodingamali (Rayagada):** A major site for OMC (Odisha Mining Corporation).

#### b. Gujarat

- **Share:** Second largest producer (~15-18%).
- **Key Locations:** The deposits are found in a belt between the Gulf of Kachchh and the Arabian Sea.
- **Districts:** Jamnagar (Kalyanpur), Devbhumi Dwarka, Junagadh, and Bhavnagar.

### c. Jharkhand

- **Key Locations:** The **Patlands** of **Lohardaga and Gumla** are famous for high-grade bauxite.
- **Districts:** Lohardaga, Gumla, Latehar, and Ranchi.

### d. Chhattisgarh & Madhya Pradesh

- **Maikala Range:** Deposits are abundant in the Maikala range covering Bilaspur and Durg (Chhattisgarh).
- **Amarkantak Plateau:** Spans across Shahdol and Mandla (MP) and Surguja (Chhattisgarh).
- **Katni (MP):** Known for specialized grades used in the refractory and chemical industries.

### 3. Top Bauxite Producing Countries

- **Australia and Guinea** are the world's leading bauxite producers, together driving global supply, with **China and Brazil** also ranking among the top producers.

### 4. Constitutional and Legal Protections for Tribal Areas

- **Fifth Schedule:** Most bauxite-rich areas in **Odisha fall under the Fifth Schedule** of the Constitution, which provides for the administration and control of Scheduled Areas and Scheduled Tribes.
- **PESA Act, 1996:** The Provisions of the Panchayats (Extension to Scheduled Areas) Act mandates that the **Gram Sabha** must be consulted before making any decision on land acquisition or mining leases in these areas.
- **Forest Rights Act (FRA), 2006:** Recognizes the rights of forest-dwelling communities over forest land and resources, requiring their consent for diversion of forest land for non-forest purposes.

### 5. Environmental and Social Concerns

- **Water Depletion:** Bauxite cappings on hills act as natural aquifers that feed perennial streams; mining these caps can lead to the drying up of water sources.
- **Displacement:** Mining often leads to the involuntary displacement of tribal communities, resulting in the loss of cultural heritage and traditional economic structures.
- **Ecological Impact:** Open-cast mining leads to large-scale deforestation and loss of biodiversity in the Eastern Ghats region.

### Q. With reference to Bauxite resources in India, consider the following statements:

1. Bauxite is primarily formed through the atmospheric weathering of rocks in tropical climates.
2. The state of Odisha possesses more than 50 percent of India's total bauxite reserves.
3. Under the PESA Act 1996, the recommendation of the Gram Sabha is mandatory for granting mining leases for minor minerals in Scheduled Areas.

### How many of the above statements are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: (c) All three**

**Solution:**

- **STATEMENT 1 IS CORRECT:** Bauxite is formed by the chemical weathering of various rocks (like limestone or basalt) under hot and humid tropical conditions, leading to the leaching of silica and the accumulation of aluminum oxides.
- **STATEMENT 2 IS CORRECT:** Odisha is the undisputed leader in bauxite resources in India, with the Eastern Ghats belt holding massive deposits.
- **STATEMENT 3 IS CORRECT:** The Provisions of the Panchayats (Extension to Scheduled Areas) Act, 1996, explicitly requires the recommendation or consent of the Gram Sabha or the Panchayats at the appropriate level before granting a prospective license or mining lease for minor minerals in the Scheduled Areas. While bauxite is a major mineral, the principle of Gram Sabha consultation is a fundamental pillar of governance in these regions.

#### 4.9. CLIMATE CHANGE AND PUBLIC HEALTH

**Context**

- **Recently**, a comprehensive report titled "*Under the Weather: India's Climate-Health Intersections and Pathways to Resilience*" was released by the **ClimateRISE Alliance** in collaboration with **Dasra**.
- The report highlights that climate change has evolved from an environmental concern into a systemic public health emergency in India, with nearly **40% of districts** now at high risk from extreme weather events. It underscores how rising temperatures and erratic rainfall are not just ecological shifts but are actively reshaping disease landscapes and straining the national healthcare infrastructure.



##### 1. Shifting Disease Patterns

Climate change acts as a **"health-risk multiplier,"** exacerbating the burden of both communicable and non-communicable diseases (NCDs).

- **Vector-Borne Diseases (VBDs):** Rising temperatures and shifting rainfall patterns are expanding the reach of malaria and dengue into previously unaffected high-altitude regions like **Shimla**, parts of **Jammu & Kashmir**, and the **Himalayan foothills**. **Pune** has been identified as a major emerging dengue hotspot.
- **Water-Borne Diseases:** Increased frequency of floods triggers outbreaks of cholera, hepatitis, and leptospirosis due to contaminated water sources.
- **Non-Communicable Diseases:** Heat exposure is directly linked to higher cardiovascular mortality. Air pollution (PM2.5) is worsening respiratory illnesses and chronic conditions.

##### 2. Socio-Economic Impact and Vulnerability

The report highlights a "cycle of vulnerability" where the impact is disproportionately borne by marginalized groups.

- **Labour Productivity:** India lost approximately **160 billion labour hours** due to heat exposure in 2021 (equivalent to ~5.4% of GDP).
- **Maternal & Child Health:** Exposure to extreme heat is linked to a **16% increase** in the odds of preterm births. It also increases risks of pre-eclampsia (high blood pressure during pregnancy) and low birth weight.
- **Vulnerable Groups:** Rural populations, informal workers (outdoor labourers), women, and children are the most "climate-vulnerable" due to limited thermoregulation abilities and poor access to healthcare.

### 3. Institutional Framework in India

India has transitioned from general climate policies to targeted health-centric interventions:

- **National Action Plan on Climate Change and Human Health (NAPCCHH):** Launched by the Ministry of Health and Family Welfare (MoHFW) to strengthen healthcare capacity against climate-sensitive illnesses.
- **Heat Action Plans (HAPs):** Implemented at city and district levels to provide early warnings and preparedness for heatwaves.
- **National Programme on Climate Change and Human Health (NPCC&HH):** Aims to create awareness, strengthen surveillance of climate-sensitive diseases, and build the capacity of healthcare professionals.

### 4. Key Challenges Identified

- **Data Gaps:** Lack of local, disaggregated data linking climate events specifically to health outcomes.
- **Funding:** Adaptation funding remains constrained and skewed heavily toward mitigation (reducing emissions) rather than building health resilience.
- **Infrastructure:** Fragmented data systems and weak public awareness hinder effective emergency responses.

### Q. Consider the following statements regarding the impact of climate change on health in India:

1. The National Action Plan on Climate Change and Human Health (NAPCCHH) is an initiative under the Ministry of Environment, Forest and Climate Change.
2. Rising temperatures have led to the expansion of vector-borne diseases like Malaria into high-altitude regions such as the Himalayan foothills.
3. According to recent reports, India lost over 5% of its GDP in 2021 due to labour hour losses caused by heat exposure.

**How many of the statements symbols above are correct?**

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: B**

### Explanation:

- **STATEMENT 1 IS INCORRECT:** The NAPCCHH is an initiative of the **Ministry of Health and Family Welfare (MoHFW)**, not the Ministry of Environment.
- **STATEMENT 2 IS CORRECT:** Climate change is shifting the ecological niche of vectors, allowing mosquitoes to survive in previously cooler regions like Shimla and the Himalayan foothills.
- **STATEMENT 3 IS CORRECT:** The Dasra/ClimateRISE report notes that India lost 160 billion labour hours in 2021, which is estimated to be equivalent to **5.4% of the GDP**.

## 4.10. YAMUNA RIVER

### Context

A tragic boat capsizing incident occurred in the **Yamuna River** in the **Mathura district** of Uttar Pradesh. The boat was carrying devotees from Punjab towards **Keshi Ghat** near Vrindavan. Preliminary reports suggest the vessel was overcrowded and collided with an iron **pontoon bridge** due



to gusty winds, leading to the accident. The National and State Disaster Response Forces (NDRF and SDRF) were deployed for rescue operations.

### 1. Geographical Profile of the Yamuna River

- **Origin:** The river originates from the **Yamunotri Glacier** on the southwestern slopes of the **Bandarpunch peaks** in the Mussoorie range of the lower Himalayas (Uttarakhand).
- **Length:** It is the longest tributary of the Ganges.
- **Confluence:** It meets the Ganges at **Prayagraj** (Allahabad), Uttar Pradesh, at a point known as the **Triveni Sangram**.
- **Basin States:** Uttarakhand, Himachal Pradesh, Haryana, Rajasthan, Delhi, and Uttar Pradesh.

### 2. Key Tributaries

Bank	Major Tributaries
Right Bank	<b>Chambal (Gandhi Sagar dam, Rana Pratap Sagar dam), Sind, Betwa, and Ken.</b>
Left Bank	<b>Hindan, Tons, and Rishi Ganga.</b>

### 3. Historical and Cultural Significance

The banks of the Yamuna are home to several significant Indian cities and heritage sites:

- **Delhi:** The national capital.
- **Agra:** Location of the Taj Mahal.
- **Mathura & Vrindavan:** Birthplace and childhood home of Lord Krishna.
- **Prayagraj (Allahabad):** Renowned for the Triveni Sangam.

#### 4. Environmental Challenges

- **Pollution:** The Yamuna is one of the most polluted rivers in the world, especially the stretch between Wazirabad and Okhla in Delhi.
- **Ammonia Levels:** Frequent "Ammonia spikes" in the river often disrupt the drinking water supply in the national capital region.

#### Q. Consider the following statements regarding the Yamuna River:

1. It originates from the Yamunotri Glacier in Uttarakhand.
2. It is the longest tributary of the Ganges.
3. It joins the Ganges at Varanasi.

Which of the statements given above are correct?

- (a) 1 and 2 only (b) 2 and 3 only  
(c) 1 and 3 only  
(d) 1, 2 and 3

**Answer: A**

**Explanation:**

**Statement 1 is Correct:** The Yamuna River originates from the **Yamunotri Glacier** located on the southwestern slopes of the Bandarpunch peaks in the Mussoorie range of the lower Himalayas, Uttarakhand.

**Statement 2 is Correct:** The Yamuna is the **longest** and the second-largest tributary of the Ganges River. It flows for approximately 1,376 kilometers before joining the Ganges.

**Statement 3 is Incorrect:** The Yamuna joins the Ganges at **Prayagraj** (formerly known as Allahabad), not Varanasi. This confluence point is famously known as the **Triveni Sangam**, where the Yamuna, Ganges, and the mythical Saraswati rivers meet.

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## 5.1. INDIA'S PROTOTYPE FAST BREEDER REACTOR (PFBR)

### Context:

- **Recently**, the 500 MWe Prototype Fast Breeder Reactor (PFBR) at Kalpakkam, Chennai, achieved "criticality," marking a historic leap in India's civil nuclear journey. This milestone signifies that the nuclear fission chain reaction within the reactor has become self-sustaining and controlled.
- Developed by **Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI)**, the PFBR serves as the essential bridge to the second stage of India's nuclear programme, paving the way for the eventual utilization of thorium for long-term energy security.



### 1. The Prototype Fast Breeder Reactor (PFBR)

- **Location:** Kalpakkam, Tamil Nadu.
- **Capacity:** 500 MWe (Megawatt electrical).
- **Agency:** Designed by **Indira Gandhi Centre for Atomic Research (IGCAR)** and built by **BHAVINI**.
- **Fuel:** Uses **Mixed Oxide (MOX) fuel**, which is a combination of Plutonium-239 (derived from Stage 1) and depleted Uranium-238.
- **Coolant:** Uses **Liquid Sodium**. Unlike water, sodium does not slow down neutrons, which is necessary for a "fast" reactor.

### 2. The "Breeder" Concept

- A breeder reactor is designed to produce more fissile material than it consumes.
- In the PFBR, neutrons trigger fission in Plutonium-239 to produce energy. Simultaneously, these "fast" neutrons convert the surrounding **Uranium-238 (blanket)** into more **Plutonium-239**.
- In the future, a **Thorium-232 blanket** will be used to breed **Uranium-233**, which is the fuel for the third stage.

### 3. India's Three-Stage Nuclear Programme

The programme was formulated by **Dr. Homi J. Bhabha** to make India self-reliant by utilizing its modest uranium and vast thorium reserves.

Stage	Reactor Type	Fuel Used	Key By-product/Goal
Stage 1	Pressurised Heavy Water Reactor (PHWR)	Natural Uranium	Plutonium-239

<b>Stage 2</b>	<b>Fast Breeder Reactor (FBR)</b>	MOX (Pu-239 + U-238)	More Pu-239 / U-233
<b>Stage 3</b>	Advanced Heavy Water Reactor (AHWR)	Thorium-232 + U-233	Energy from Thorium

#### 4. Technical and Safety Features

- **Pool-type Reactor:** The entire primary circuit (core, pumps, and heat exchangers) is immersed in a large pool of liquid sodium, providing high thermal inertia (safety against overheating).
- **Closed Fuel Cycle:** The **Demonstration Fast Reactor Fuel Reprocessing Plant (DFRP)** at Kalpakkam is designed to "close" the loop by reprocessing spent fuel from the FBR to extract plutonium and unburnt uranium.
- **Liquid Sodium Challenge:** Sodium is highly reactive with air and water; hence, the reactor requires sophisticated leak-detection and intermediate cooling loops.

#### Q. With reference to the Prototype Fast Breeder Reactor (PFBR) at Kalpakkam, consider the following statements:

1. It utilizes liquid sodium as a coolant because sodium does not moderate (slow down) neutrons.
2. The reactor is designed to function as a "bridge" to Stage 3 by producing Uranium-233 from a Thorium blanket.
3. Unlike the first-stage PHWRs, the PFBR operates on a closed fuel cycle where spent fuel is reprocessed.

#### How many of the above statements are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: (c) All three**

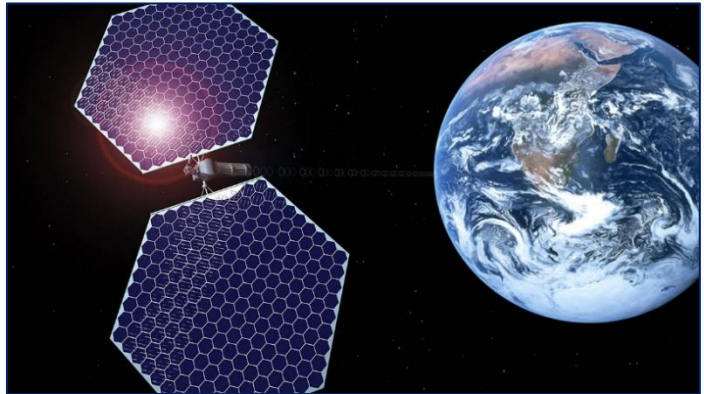
#### Solution:

- **STATEMENT 1 IS CORRECT:** Fast breeder reactors require "fast" neutrons to sustain the breeding process. Sodium is a heavy atom compared to hydrogen (in water) and does not slow down neutrons significantly.
- **STATEMENT 2 IS CORRECT:** The PFBR will eventually use Thorium-232 in its blanket to breed Uranium-233, which is the essential fissile material for the third stage of the nuclear programme.
- **STATEMENT 3 IS CORRECT:** Stage 2 is explicitly based on a closed fuel cycle. The spent fuel is reprocessed at the onsite DFRP to recover plutonium for further use, unlike the "once-through" cycle often used in some older reactor designs.

## 5.2. SPACE-BASED SOLAR POWER (SBSP)

### Context:

- **Recently**, the global scientific community has intensified its focus on sustainable energy alternatives, with the **Artemis II mission** achieving record-breaking lunar flybys in April 2026, renewing interest in lunar-based infrastructure.
- Against this backdrop, concepts like the **Shimizu Corporation's "Lunar Ring"**—a proposed 11,000 km belt of solar power plants on the moon's equator—have moved from speculative science fiction to serious academic and policy discussion. These systems aim to collect uninterrupted solar energy and beam it back to Earth via microwave radiation to provide a constant, clean power source.



These systems aim to collect uninterrupted solar energy and beam it back to Earth via microwave radiation to provide a constant, clean power source.

### 1. What is Space-Based Solar Power?

SBSP refers to the collection of solar energy in outer space (either in Earth's orbit or on the lunar surface) and its subsequent transmission to Earth.

#### Working Mechanism:

- **Collection:** Large solar arrays or mirrors reflect sunlight onto photovoltaic cells.
- **Conversion:** The electricity generated is converted into **microwaves** or **laser beams**.
- **Transmission:** These beams are transmitted through the atmosphere to a ground-based receiving antenna (often called a **rectenna**).
- **Re-conversion:** The rectenna converts the microwave/laser energy back into electricity for the grid.

### 2. Key Concepts & Projects

- **Lunar Ring (Luna Ring):** A Japanese proposal (Shimizu Corp) to build a solar belt around the moon's equator. It utilizes **In-Situ Resource Utilization (ISRU)**, where robots build the structure using lunar soil (regolith).
- **Constant Energy:** Unlike Earth-based solar, an orbital satellite or a 360-degree lunar ring can collect sunlight **24/7**, regardless of weather, seasons, or day-night cycles.
- **Wireless Power Transfer (WPT):** The fundamental technology used to "beam" energy across the vacuum of space.

### 3. Advantages Over Terrestrial Solar

- **High Intensity:** Solar radiation in space is roughly **35-40%** more intense than on Earth's surface due to the absence of atmospheric scattering.
- **Zero Intermittency:** Space-based systems are not affected by cloud cover, dust, or the 12-hour night cycle.
- **Global Reach:** Energy can theoretically be beamed to any location on Earth, including remote islands or disaster-hit zones.

#### 4. Critical Challenges

- **Economics:** The "levelized cost of energy" remains prohibitively high due to the massive cost of launching thousands of tonnes of hardware.
- **Transmission Loss:** Significant energy is lost as **heat** during the conversion and atmospheric entry phases.
- **Space Debris:** The **Kessler Syndrome** (cascading collisions) poses a major risk; a single piece of debris could destroy a billion-dollar array.
- **Environmental Impact:** Potential heating of the ionosphere or release of hazardous chemicals during frequent rocket launches required for assembly.
- **Maintenance:** Dependence on **tele-robotics** since human-led maintenance in high orbits (GEO) or on the moon is extremely costly and dangerous.

#### 5. Institutional & Global Efforts

- **ISRO (India):** Has expressed interest in SBSP as part of its long-term space vision to ensure energy security.
- **China:** Developing "Bishantai," a space-based solar power station test facility.
- **Caltech (USA):** Recently demonstrated the first successful wireless power transfer from space to Earth via the **MAPLE** experiment.

#### Q. With reference to Space-Based Solar Power (SBSP), consider the following statements:

1. SBSP systems can provide "round-the-clock" electricity, bypassing the intermittency issues of ground-based solar power.
2. The "Lunar Ring" concept involves the use of lunar regolith to construct solar arrays on the moon's equator.
3. Microwave transmission of power from space is preferred over laser beams because microwaves are less affected by atmospheric conditions like rain or clouds.

#### How many of the above statements are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: C**

#### Solution:

- **STATEMENT 1 IS CORRECT:** Unlike terrestrial solar, space-based satellites in high orbits or a lunar ring can stay in sunlight almost 100% of the time, providing constant baseload power.
- **STATEMENT 2 IS CORRECT:** The Shimizu Corporation's proposal specifically mentions using robots to process lunar soil (regolith) to build the 11,000 km infrastructure.
- **STATEMENT 3 IS CORRECT:** Microwaves can pass through clouds and rain with minimal loss compared to laser beams, which are easily scattered or blocked by atmospheric moisture, making microwaves more reliable for all-weather power delivery.

### 5.3. PULSARS AND DEEP SPACE NAVIGATION

#### Context:

- **Recently**, Indian astronomers have pioneered a more accurate method to measure distances in the universe by studying the radio emissions of **Pulsars** as they travel through ionized gas clouds in the Milky Way.
- Published in the *Monthly Notices of the Royal Astronomical Society*, the research focuses on how signals from these pulsating stellar remnants are distorted by the interstellar medium, specifically using the **Vela pulsar wind nebula** as a primary subject of study. This breakthrough addresses long-standing inaccuracies in distance estimation caused by turbulent plasma in complex regions of our galaxy.



#### 1. What are Pulsars?

Pulsars (short for Pulsating Radio Sources) are highly magnetized, rapidly rotating **Neutron Stars**—the dense cores left behind after a massive star undergoes a supernova explosion.

- **Emission Mechanism:** They emit beams of electromagnetic radiation (radio waves) from their magnetic poles. Because these beams sweep across Earth like a lighthouse beam, they appear as "pulses."
- **Cosmic Clocks:** Due to their extraordinarily stable rotation rates, pulsars are used as high-precision timekeepers, similar to atomic clocks on Earth.
- **Millisecond Pulsars:** These spin hundreds of times per second and are critical for detecting gravitational waves.

#### 2. Measuring Distance: The "New Way"

Traditional methods often rely on models of electron distribution which can be unreliable. The new method combines two distinct physical effects:

- **Dispersion Measure (DM):** As radio waves travel through the interstellar medium, free electrons slow down lower-frequency waves more than higher-frequency ones. By measuring this delay, scientists estimate the number of electrons between Earth and the pulsar.
- **Scatter Broadening:** Interstellar plasma is not smooth; its irregularities scatter radio waves, causing the signal to appear "smeared" or stretched. This is similar to the twinkling of stars but occurs in the radio spectrum.
- **The "k-factor":** The researchers combined DM and scattering into a single parameter called the \$k-factor\$ to refine distance estimates in complex regions like the **Gum Nebula**.

#### 3. Comparison with Parallax Method

- **Parallax Method:** Considered the "gold standard," it uses trigonometry to measure distances based on the Earth's orbit. However, it has a "hard limit" and becomes less effective for objects at extreme distances.
- **The Novel Method:** Does not have a specific distance limitation. It can potentially be used to measure distances to objects outside the Milky Way, such as **Fast Radio Bursts (FRBs)**.

#### 4. Key Institutions and Regions Involved

- **IIT-Kanpur & Raman Research Institute:** Leading Indian institutions involved in the study.
- **Gum Nebula:** A vast region of ionized gas where the new model was tested against 10 different pulsars.
- **Vela Pulsar Wind Nebula:** A key celestial target used to validate the scattering and dispersion models.

#### Q. With reference to 'Pulsars' and space distance measurement, consider the following statements:

1. Pulsars are rapidly spinning remnant cores of dead stars that emit regular beams of radio waves.
2. The Dispersion Measure (DM) method relies on the fact that interstellar free electrons slow down higher-frequency radio waves more than lower-frequency ones.
3. Unlike the Parallax method, the novel scattering-based distance measurement technique has no specific distance limitation.

#### How many of the above statements are correct?

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: B**

#### Solution:

- **STATEMENT 1 IS CORRECT:** Pulsars are indeed the dense, rotating cores of neutron stars that act like cosmic lighthouses.
- **STATEMENT 2 IS INCORRECT:** In the interstellar medium, free electrons slow down **lower-frequency** radio waves more than higher-frequency ones. This causes different frequencies to arrive at Earth at slightly different times.
- **STATEMENT 3 IS CORRECT:** While the Parallax method is limited by the geometry of Earth's orbit, the scattering-based method can theoretically be applied to very distant objects, including those outside our galaxy.

### 5.4. GAGANYAAN - INDIA'S HUMAN SPACEFLIGHT PROGRAMME

#### Context:

- **Recently**, discussions regarding the safe return and recovery of Indian astronauts under the **Gaganyaan Mission** have gained prominence as ISRO intensifies its testing phase. As of April 2026, with the uncrewed G1 mission on the horizon, the focus has shifted toward the critical "Descent and Recovery" phase.



- Unlike the Russian Soyuz or Chinese Shenzhou which primarily use land-based landings, India's Gaganyaan will utilize a water-based splashdown in the **Bay of Bengal**, necessitating a complex multi-stage parachute system and coordinated naval recovery operations.

## 1. Mission Overview

The Gaganyaan programme aims to demonstrate India's indigenous capability to send a human crew to **Low Earth Orbit (LEO)** and bring them safely back to Earth.

- **Orbit:** 400 km circular orbit.
- **Duration:** 1 to 3 days (expandable up to 7 days).
- **Crew:** 3 members (Astronaut-designates: Gp Capt P.B. Nair, Gp Capt Ajit Krishnan, Gp Capt Angad Pratap, and Wg Cdr Shubhanshu Shukla).
- **Landing:** Planned splashdown in the **Indian Ocean**.

## 2. Spacecraft Components

The Gaganyaan spacecraft, known as the **Orbital Module**, consists of two main parts:

- **Crew Module (CM):** A double-walled, pressurized habitable space designed to maintain an Earth-like environment (temperature, oxygen, humidity) for the astronauts.
- **Service Module (SM):** An unpressurized structure containing the propulsion system, power systems (solar arrays), and avionics to support the CM in orbit.

## 3. Launch Vehicle: Human-Rated LVM3 (HLVM3)

ISRO's heavy-lift launcher, **LVM3**, has been re-configured to meet "Human Rating" standards, ensuring high reliability and safety.

- **Three Stages:**
  1. **S200 Solid Boosters:** Two large solid motors.
  2. **L110 Liquid Core:** Powered by clustered Vikas engines.
  3. **C25 Cryogenic Stage:** Powered by the CE-20 engine (liquid hydrogen and liquid oxygen).
- **Safety Factor:** Includes an **Integrated Health Monitoring System** to detect anomalies in real-time.

## 4. Key Safety and Technology Elements

- **Crew Escape System (CES):** A crucial safety mechanism that can pull the Crew Module away from the rocket in case of an emergency during launch or ascent.
- **Environmental Control and Life Support System (ECLSS):** Maintains pressure, removes CO<sub>2</sub>, and manages waste and temperature.
- **Vyommitra:** A female-looking humanoid robot ("Half-humanoid") designed to simulate human functions and monitor module parameters during uncrewed missions to ensure safety before humans fly.

## 5. Phases of the Mission

1. **TV-D1 (Test Vehicle Abort Mission):** Successfully demonstrated the Crew Escape System in October 2023.
2. **Gaganyaan G1 (Uncrewed):** Expected in 2026; will carry Vyommitra.
3. **Gaganyaan G2:** Second uncrewed mission for final system validation.

4. **H1 (Manned Mission):** The final crewed flight (tentatively 2026-2027).

**Q. With reference to the Gaganyaan Mission, consider the following statements:**

**Statement-I:** The LVM3 rocket used for Gaganyaan is a three-stage launch vehicle that utilizes a cryogenic engine in its final stage.

**Statement-II:** The humanoid robot 'Vyommitra' is designed to remain in the Service Module to control the propulsion and power systems during the uncrewed flight.

**Which one of the following is correct in respect of the above statements?**

- (a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
- (b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
- (c) Statement-I is correct but Statement-II is incorrect.
- (d) Statement-I is incorrect but Statement-II is correct.

**Answer: C**

**Solution:**

- **STATEMENT I CORRECT:** The LVM3 (Human-Rated) is indeed a three-stage vehicle consisting of solid boosters, a liquid core, and a cryogenic upper stage (CE-20).
- **STATEMENT II INCORRECT:** Vyommitra is a humanoid robot placed inside the **Crew Module** (not the Service Module) to simulate human presence, monitor cabin parameters, and operate switches to test the life-support systems.

## 5.5. INDIA'S FIRST QUANTUM REFERENCE FACILITY

**Context:**

- Recently, the Andhra Pradesh state government announced that India's first **quantum computing testing beds**, known as the **Amaravati Quantum Reference Facility (AQR)**, will be launched. The facility is scheduled to be dedicated to the nation by Honorable Chief Minister N. Chandrababu Naidu on **April 14**, a date that coincides with **World Quantum Day**.
- This initiative is part of the "**Amaravati Quantum Valley**" programme, making Andhra Pradesh the first state in the country to take such a significant step in quantum infrastructure.



### 1. Core Significance and Functionality

- **The Reference Gap:** Prior to this launch, India did not have a dedicated quantum testing computer that could serve as a **reference** to validate various components of the burgeoning quantum computing ecosystem.

- **Testing Bed:** The AQRF will function as a standardized platform where researchers and scientists can test and assemble quantum hardware and software components.
- **Location:** The testing beds are being developed and hosted at **SRM University, Andhra Pradesh**.

## 2. Collaborative Framework

The development involves a specialized team of 50 researchers, students, and scientists working on building the ecosystem. The project is a partnership between:

- **SRM University A.P.**
- **Amaravati Quantum Research Facility**
- **Qubit Force**

## 3. What is Quantum Technology?

- Quantum science studies how **matter and energy** behave at very small scales—atoms, electrons, and photons.
- It is based on **Quantum Mechanics**, which explains phenomena that classical physics cannot.
- **Quantum technology** leverages the principles of **quantum mechanics**—specifically **superposition, entanglement, and tunneling** (Particles pass through barriers)—to perform tasks impossible for conventional technologies.

## 4. Key Pillars of Quantum Technology

- **Quantum Computing:** Instead of binary bits (0 or 1), quantum computers use **qubits** that can exist in multiple states simultaneously (**superposition**). This allows them to process complex problems exponentially faster than classical supercomputers.
- **Quantum Communications:** Utilizing principles like **quantum entanglement**, this technology ensures secure communication channels, such as Quantum Key Distribution (QKD), which makes eavesdropping physically impossible to go undetected.
  - **Entanglement:** Particles become connected, sharing information instantly regardless of distance.
- **Quantum Sensing:** These sensors measure **environmental changes** with unprecedented precision. Examples include atomic-level MRI scans for early cancer detection and navigation systems that do not require GPS.
- **Quantum Materials:** Research into engineering materials that exhibit quantum properties, which can lead to new electronic devices or energy solutions.

## 5. Applications

- **Quantum Computing** – Fast computation, optimization, AI, drug discovery
- **Quantum Cryptography** – Ultra-secure communication (QKD)
- **Quantum Communication** – Secure satellite & fiber-based data transfer
- **Quantum Sensing** – High-precision measurement (gravity, magnetic fields)
- **Atomic Clocks** – Ultra-accurate timekeeping (GPS, navigation)
- **Healthcare & Pharma** – Drug discovery, molecular simulation
- **Cybersecurity** – Next-gen encryption systems
- **Artificial Intelligence** – Faster machine learning & big data processing

- **Finance** – Risk analysis, portfolio optimization
- **Climate Modeling** – Better prediction of climate change
- **Material Science** – Development of new materials (superconductors, etc.)
- **Space Technology** – Satellite communication, deep-space navigation
- **Defence & Military** – Secure communication, advanced radar systems
- **Energy Sector** – Battery design, nuclear simulations

## 6. About National Quantum Mission

- **Launched:** For a period from 2023-24 to 2030-31 by Department of Science and Technology (DST).
- **Objectives of National Quantum Mission (Concise)**
  - **Quantum Computing:** Develop quantum computers with 20–50 qubits (3 yrs), 50–100 (5 yrs), and up to 1000 (8 yrs) using superconducting & photonic technologies.
  - **Quantum Communication (Satellite):** Establish 2000 km satellite-based secure quantum communication within India and extend globally.
  - **Quantum Key Distribution (QKD):** Enable 2000 km secure communication over optical fiber using trusted nodes & WDM.
  - **Quantum Networks:** Build multi-node quantum networks (2–3 nodes) using entanglement, quantum repeaters & memories.
  - **Quantum Sensing & Clocks:** Develop high-precision sensors (magnetometers, gravity sensors) and ultra-accurate atomic clocks.
  - **Quantum Materials & Devices:** Develop advanced materials (superconductors, semiconductors) for qubits, photon sources, and quantum devices.
- **Implementation Strategy: Thematic Hubs (T-Hubs)**
  - **Under the National Quantum Mission,** 4 Thematic Hubs (T-Hubs) drive quantum innovation nationwide. They integrate 14 Technical Groups across 17 states and 2 UTs for research and development.
- **Key Institutions:**
  - IISc Bengaluru
  - IIT Madras (with C-DOT, New Delhi)
  - IIT Bombay
  - IIT Delhi

### Q. Consider the following statements regarding the 'Amaravati Quantum Reference Facility' (AQRF):

1. It is India's first dedicated testing bed for validating quantum computing ecosystem components.
2. The facility is being launched under the "Amaravati Quantum Valley" programme of the Andhra Pradesh government.
3. It was developed exclusively by the Defence Research and Development Organisation (DRDO).

### Which of the statements given above are correct?

- (a) 1 and 3 only  
(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2, and 3

**Answer: B**

**Explanation:**

**Statement 1 is Correct:** The **Amaravati Quantum Reference Facility (AQR)** is established as India's first **quantum computing testing beds**. Its primary purpose is to serve as a reference to test and validate different components of the quantum computing ecosystem, a facility that the country previously lacked.

**Statement 2 is Correct:** This facility is a key initiative under the "**Amaravati Quantum Valley**" programme launched by the **Andhra Pradesh** state government. It marks Andhra Pradesh as the first state in India to take up such an initiative.

**Statement 3 is Incorrect:** The facility was not developed exclusively by the DRDO. According to the report, it is a collaborative effort developed at **SRM University A.P.** in partnership with the **Amaravati Quantum Research Facility** and **Qubit Force**. A team of 50 researchers, students, and scientists is involved in assembling this ecosystem.

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# HISTORY & CULTURE

## 6.1. CHAR DHAM YATRA

### Context:

The sacred Char Dham Yatra in Uttarakhand has recently been scheduled to commence from April 19, 2026, marking the beginning of one of the most significant pilgrimages in Hinduism.

The Char Dham Yatra is one of the most sacred Hindu pilgrimages in India, located in the Garhwal region of Uttarakhand. It consists of four holy sites nestled in the Himalayas, traditionally visited in a specific clockwise direction (Parikrama).

### 1. About Char Dham:

The 4 Dham (Char Dham) refers to two sets of sacred Hindu pilgrimages. The primary Bada Char Dham (nationwide) includes Badrinath (North), Puri (East), Rameswaram (South), and Dwarka (West), established to promote national unity. The Chota Char Dham (Himalayas) features Yamunotri, Gangotri, Kedarnath, and Badrinath, usually visited from May to October.



### 2. The Four Sacred Sites

- **Yamunotri:** Dedicated to **Goddess Yamuna**. It is the first stop and the source of the Yamuna River. Pilgrims often cook rice in the Surya Kund (hot springs) as *Prasad*.
- **Gangotri:** Dedicated to **Goddess Ganga**. Located on the banks of the Bhagirathi River, it marks the place where the Ganges is said to have descended from heaven.
- **Kedarnath:** One of the 12 **Jyotirlingas** dedicated to **Lord Shiva**. Located in Rudraprayag district of Uttarakhand at an altitude of 3584 m near the **Mandakini River**, is a sacred abode of Lord Shiva and one of the 12 Jyotirlingas.
- **Badrinath:** Badrinath Temple, situated at 3415 m in the Garhwal Himalayas along the **Alaknanda River**, is a major Char Dham shrine dedicated to Lord Vishnu (Badri form). Linked to his penance under the Badri tree, it houses a meditative shaligram idol, was revived **by Adi Shankaracharya** in the 9th century.

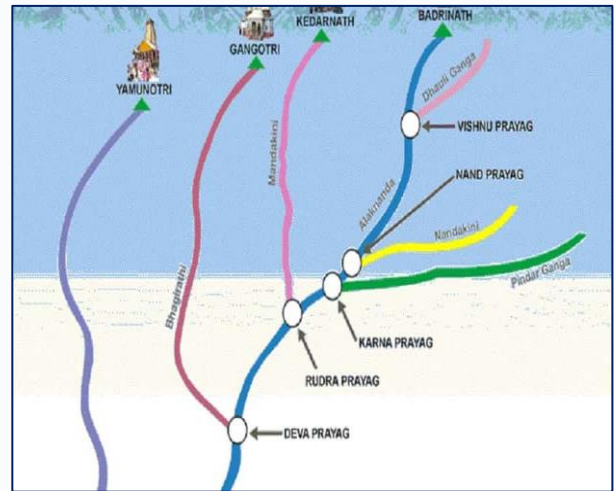
### 3. Winter Char Dham Circuit

During winter (typically November to April/May), the high-altitude Char Dham deities in Uttarakhand are moved to lower altitudes to allow for continued worship.

- Kedarnath moves to Omkareshwar Temple in **Ukhimath**.
- Badrinath moves to Yogadhyan Badri in Pandukeshwar/Joshimath.
- Gangotri moves to Mukhba village.
- Yamunotri moves to Kharsali (Khushimath).

**4. Panch Prayag**

The Panch Prayag refers to five sacred river confluences in the Garhwal Himalayas of Uttarakhand, India, where tributaries meet the Alaknanda River before it becomes the Ganga at Devprayag. These sites—**Vishnuprayag, Nandaprayag, Karnaprayag, Rudraprayag, and Devprayag.**



- **Vishnuprayag:** Confluence of **Dhauliganga** and Alaknanda; linked to sage Narada and a Vishnu temple.
- **Nandaprayag:** Meeting of Alaknanda and **Nandakini**; associated with King Nanda’s yajna.
- **Karnaprayag:** Confluence of Alaknanda and **Pindar**; linked to Karna’s penance.
- **Rudraprayag:** Meeting of Alaknanda and **Mandakini**; associated with Lord Shiva.
- **Devprayag:** Confluence of Alaknanda and **Bhagirathi** forming the Ganga; the most sacred.

**Q. With reference to Panch Prayag, consider the following statements:**

1. All five confluences involve the Alaknanda River.
2. Rudraprayag is the meeting point of Mandakini and Bhagirathi rivers.
3. Karnaprayag is associated with Karna from the Mahabharata.

Which of the statements given above is/are correct?

- (a) 1 and 3 only
- (b) 2 and 3 only
- (c) 1 only
- (d) 1, 2 and 3

**Answer: A**

**Explanation:**

**Statement 1 is Correct:** The **Alaknanda River** is the common thread in all five confluences. It originates from the Satopanth Glacier and flows through each "Prayag," meeting a different tributary at every stage until it finally meets the Bhagirathi to form the Ganga.

**Statement 2 is Incorrect:** **Rudraprayag** is the meeting point of the **Alaknanda** and the **Mandakini** (which flows from Kedarnath). The meeting point of the **Bhagirathi** and the **Alaknanda** is actually **Devprayag**, which is the final of the five prayags where the river officially becomes the **Ganga**.

**Statement 3 is Correct:** **Karnaprayag** is where the **Alaknanda** meets the **Pindar River**. Local tradition and mythology hold that this is the place where **Karna** of the Mahabharata meditated to please Surya (the Sun God) and received his indestructible armor (*Kavacha*) and earrings (*Kundala*).

## 6.2. THE ELEPHANTA RESERVOIR AND KALACHURI DYNASTY

### Context

- **Recently**, the Archaeological Survey of India (ASI) unearthed a significant 1,500-year-old stepped reservoir at Morabandar on **Elephanta Island** (also known as **Gharapuri**) near Mumbai.
- This discovery is monumental because it reveals a sophisticated, **engineered water management system** distinct from the island's famous rock-cut caves.
- The excavation also yielded silver and copper coins of the **Kalachuri ruler Krishnaraja** and imported pottery, providing vital links to ancient global trade networks.



### 1. Archaeological Highlights of the Discovery

- **Structure:** It is a massive **T-shaped stepped reservoir** approximately **14.7 meters long**, built with perfectly aligned stone blocks ferried from the mainland.
- **Engineering:** Unlike the existing rock-cut cisterns on the island, this is a **built structure**, signifying a mature phase of ancient civil engineering designed to tackle the island's rocky terrain and freshwater scarcity.
- **Location:** The site is located at **Morabandar**, one of the three ancient port localities on the island (the others being Rajbandar and Shethbandar).
- **Associated Artifacts:** Excavations revealed a **dyeing vat** for textiles, terracotta figurines, stone anchors, and over 3,000 potsherds.

### 2. The Kalachuri Dynasty of Mahishmati

- **Timeline:** Ruled during the **6th and 7th centuries CE** over parts of present-day Maharashtra, Gujarat, and Malwa.
- **Key Ruler (Krishnaraja):** The earliest known powerful king of this dynasty (c. 550–575 CE). He was a **Parama-Maheshvara** (devotee of Shiva).
- **Numismatic Evidence:** Coins found at the site feature a **seated bull (Nandi)** on the obverse and a temple symbol with the legend **"Siri Krishnaraja"** on the reverse. These coins were widely circulated and served as a standard currency in the Western Deccan for decades.
- **Cultural Legacy:** Scholars believe the main Shiva complex (Cave 1) at Elephanta was likely patronized during the Kalachuri reign.

### 3. Ancient Maritime Trade Networks

- **Amphorae Sherds:** Discovery of Mediterranean **amphorae** (used for wine and oil) indicates strong trade links with the **Roman Empire**.
- **Torpedo Jars:** These vessels originate from **Mesopotamia (West Asia)** and were used to transport fish sauce and oils.

- **Strategic Port:** The findings confirm Elephanta Island as a critical maritime hub connecting the Indian mainland with the Persian Gulf and the Mediterranean during the Early Historic period.

#### 4. Elephanta Caves

- **UNESCO Status:** Designated as a World Heritage Site in **1987**.
- **Architecture:** Famous for rock-cut basalt sculptures, primarily dedicated to **Lord Shiva**.
- **Iconography:** Notable for the **Trimurti Sadashiva** (three-faced Shiva representing Creator, Preserver, and Destroyer), **Nataraja, and Ardhanarishvara**.
- **Historical Layers:** While predominantly **Shaivite (5 Hindu caves)**, the island also contains **two Buddhist caves**.
- **Gujarat Sultanate** surrendered Elephanta to the **Portuguese** in 1534 who named the island “**Elephanta Island**” in honour of a huge rock-cut black stone statue of an elephant that was then installed on a mound.

**Q. With reference to the recently discovered 1,500-year-old reservoir on Elephanta Island, consider the following statements:**

1. The reservoir is a rock-cut cistern excavated directly into the basalt hills of Gharapuri.
2. Artifacts found at the site include amphorae of Mediterranean origin, suggesting ancient maritime trade.
3. Numismatic evidence from the site confirms the presence of the Kalachuri dynasty in the 6th century CE.

**How many of the statements given above are correct?**

- (a) Only one
- (b) Only two
- (c) All three
- (d) None

**Answer: B**

**Solution:**

- **STATEMENT 1 IS INCORRECT:** According to the Archaeological Survey of India, this specific reservoir is a **built structure** using stone blocks ferried from the mainland, not a rock-cut cistern.
- **STATEMENT 2 IS CORRECT:** Archaeologists recovered over 3,000 sherds of Mediterranean amphorae and West Asian torpedo jars, proving the island's role in long-distance trade.
- **STATEMENT 3 IS CORRECT:** Several copper and silver coins belonging to the Kalachuri ruler **Krishnaraja** (6th century CE) were identified based on the seated bull motif and the king's legend.

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