DAILY CURRENT AFFAIRS 11-04-2026

Mapping Perspective

1. **Mount Semeru**

Prelims Perspective

2. **Arogya Van Initiative**
3. **Cornstarch**

Mains Perspective

4. **National Quantum Mission**
5. **How FBR Strengthens India's Nuclear Energy Strategy**

Mount Semeru

Syllabus: GS-1: Physical Geography – Volcanoes.

Context:

- Recently, **Mount Semeru in Indonesia erupted multiple times**, sending thick columns of ash up to **1,100 metres above its summit**.

About Mount Semeru

Location & Physical Features

- **Location:** Located in East Java, Indonesia
- One of the most active volcanoes in Indonesia
- At **3,676 metres (12,060 feet)**, it is the highest peak on Java Island
- Lies at the southern end of a volcanic massif extending north to the Tengger caldera

Geological Characteristics

- Positioned within a **subduction zone**, where the **Indo-Australian plate subducts beneath the Eurasia plate**
- Part of the **Pacific "Ring of Fire"**, associated with high volcanic and seismic activity
- Summit topography is complicated by the shifting of craters from **NW to SE**

Eruptive Nature

- Also known as **Mahameru**
- Has erupted numerous times in the past **200 years**
- Known for **regular ash explosions** occurring at intervals of **10–30 minutes**

Value Addition

- Illustrates **plate tectonics (subduction zones)** and **volcanism in Ring of Fire**
- Important example for **active stratovolcano behaviour and hazard assessment**
- Relevant for **disaster management and volcanic risk zones**

Arogya Van Initiative

Syllabus: GS-3: Development and Environment.

Context:

- Recently, the National Highways Authority of India has announced a new initiative called **'Arogya Van'**

About the Initiative

- A new initiative to develop **thematic medicinal tree plantations** on vacant land parcels along the **National Highways**
- Aims to **enrich biodiversity** by introducing medicinal tree species supporting **pollinators, birds and microfauna**, thereby strengthening **ecosystem resilience**

Implementation & Coverage

- In the **first phase**, an action plan covers **17 land parcels** along different National Highway projects
- States covered: **Madhya Pradesh, Haryana, Delhi-NCR, Andhra Pradesh, Gujarat, Karnataka, Odisha, Tamil Nadu, Rajasthan, Maharashtra and Chhattisgarh**
- Tree species with **established medicinal properties** identified and planted as per **agro-climatic suitability**

Priority Areas

- Priority to land parcels near **toll plazas, wayside amenities, interchanges, cloverleaf junctions and other prominent stretches** along National Highways

Nodal Ministry

- Ministry of Road Transport and Highways

Analytical Angle

- Links **infrastructure development with ecological sustainability**
- Promotes **green highways, biodiversity conservation and climate resilience**
- Supports **pollinator health → agricultural productivity linkages**

Cornstarch

Syllabus: GS-3: General Science.

Context:

- Recently, researchers reported that at an extreme speed, the cornstarch mixture behaves like a liquid first before becoming tougher **(non-Newtonian behaviour).**

About Cornstarch

- It is a substance produced through wet **milling of corn (*Zea mays*).**
- Wet milling separates the components of corn kernels → **protein, fibre, starch, and oil.**
- Once separated, **the starch is dried** → forming a white powder called cornstarch.
- Cornstarch is high in carbohydrates but lacking in vitamins, protein, fibre, and minerals → **one of the least nutritionally dense components of corn**.

Applications of Cornstarch

- **Absorbs moisture** → useful as a thickener and anticaking agent in food products.
- **Used in certain oral medications** → facilitates disintegration of capsules and tablets.
- **Used as a substitute for wheat flour** in gluten-free foods and as a substitute for baby powder.
- **Used in food processing, papermaking**, industrial adhesives → also a component of cosmetics and oral pharmaceutical products.
- Used as a l**ubricant** in surgical gloves.

National Quantum Mission

Syllabus: GS-3: Science and Technology – Information and Commination Technology.

Context:

- The Union Minister said that India has successfully demonstrated a **1,000-kilometre quantum communication network** under the National Quantum Mission, marking a **major breakthrough in secure communication technologies**.

About National Quantum Mission (NQM)

- Launched by the **Department of Science & Technology** with a total outlay of **Rs.6003 crore** for a period from **2023-24 to 2030-31**
- Aims to **seed, nurture and scale up scientific and industrial R&D** and create a **vibrant & innovative ecosystem in Quantum Technology (QT)**
- It is **one of the nine initiatives under the Prime Minister's Science Technology Innovation Advisory Council (PMSTIAC)**

Implementation Strategy

- Implemented by establishing **four Thematic Hubs (T-Hubs)** across leading institutions in India
- Each T-Hub follows the **Hub-Spoke-Spike model**

Key Focus Areas under NQM

1. Quantum Computing

- Led by the **Indian Institute of Science (IISc), Bengaluru**

2. Quantum Communication

- Led by the **Indian Institute of Technology (IIT), Madras** in association with the **Centre for Development of Telematics, New Delhi**

3. Quantum Sensing & Metrology

- Spearheaded by the **Indian Institute of Technology (IIT), Bombay**

4. Quantum Materials & Devices

- Coordinated by the **Indian Institute of Technology (IIT), Delhi**

Analytical Insight

- Strengthens **secure communication infrastructure** (cybersecurity, strategic sector relevance)
- Promotes **self-reliance in frontier technologies** (aligned with Atmanirbhar Bharat)

- Enhances India's position in **global quantum race and emerging technologies**

How FBR Strengthens India's Nuclear Energy Strategy

Syllabus: GS-3: Indian Economy – Energy Sector.

Context:

- **India's Prototype Fast Breeder Reactor** (PFBR) at Kalpakkam achieved criticality on April 6, 2026, marking a key milestone in its nuclear programme
- "Criticality" is not the final goal but the initial stage of reactor operation; it signals beginning of controlled nuclear chain reaction, not completion

Criticality in Nuclear Reactors

- **Criticality** → self-sustaining chain reaction where each fission releases neutrons triggering further fission
- Engineers regulate fuel composition, neutron movement, and temperature to maintain stability
- Indicates stable controlled reaction but not readiness for commercial operation
- **Post-criticality** → reactor operated at low power for long periods to validate design parameters

Conventional PHWRs and Limitations

- Most Indian reactors are **Pressurised Heavy Water Reactors** (PHWRs) using natural uranium (99.3% U-238, 0.7% U-235)
- **Moderator slows neutrons** → enables U-235 fission producing heat, plutonium, and neutrons
- **Major limitation** → only ~1% of fuel utilised before becoming unusable (low efficiency)

Working of Fast Breeder Reactors (FBRs)

- **Higher efficiency** → fuel utilisation ~10% or more
- Use plutonium as fuel; no neutron moderation (fast neutrons used)
- **Core surrounded by depleted uranium blanket** → fast neutrons convert uranium into plutonium
- **Plutonium reprocessed and reused** → continuous fuel generation cycle

- System both generates energy and breeds additional fuel → enhances efficiency and sustainability

India's Three-Stage Nuclear Programme

- Conceptualised by Homi J. Bhabha for long-term energy security

Stage I

- **PHWRs use natural uranium** → produce electricity + plutonium + depleted uranium

Stage II

- **FBRs utilise plutonium** + depleted uranium → generate more energy + additional plutonium

Stage III

- **Advanced reactors use plutonium** + thorium → exploit India's thorium reserves
- **FBRs act as bridge between uranium**-based and thorium-based cycle → enable nuclear self-sufficiency

Challenges in Developing FBRs

Technical Complexity and Delays

- Development more difficult than anticipated; PFBR faced construction challenges

Liquid Sodium Coolant Issues

- **Sodium coolant** → efficient heat transfer, no high-pressure requirement
- **But reacts violently with air/water** → requires sealed systems and strict leak detection
- Global examples:
  - **Japan's Monju** → sodium leak and fire → shutdown
  - **France's Superphénix** → closed due to technical issues and high cost
  - **Russia** → limited operational FBRs showing feasibility

Economic and Public Acceptance Issues

- Not yet economically viable; high cost and safety concerns hinder adoption

Safety and Oversight Requirements

- Requires rigorous monitoring, engineering precision, and strong safety culture

India's Approach to FBRs

Strategic Objective

- Focus on long-term fuel security through three-stage programme

Governance Structure

- Nuclear sector largely state-controlled; Department of Atomic Energy reports to Prime Minister's Office
- Ensures continuity across political cycles

Accountability and Transparency Issues

- Insulated decision-making → reduced scrutiny and accountability
- PFBR cost escalation ₹3,500 crore → ₹6,800 crore with multiple delays

Conclusion

- PFBR criticality marks technological progress but not operational completion
- FBRs are pivotal for India's nuclear energy strategy, yet constrained by technical, economic, and governance challenges
- Long-term success depends on balancing technological capability with safety, cost efficiency, and institutional accountability