FAST BREEDER REACTORS: INDIA'S NUCLEAR STRATEGY

India's Prototype Fast Breeder Reactor (PFBR) at Kalpakkam achieved criticality on April 6, 2026, marking a key milestone in its nuclear programme.

While "criticality" is often seen as a major achievement, it is not the final goal but actually the initial stage of reactor operation. It represents the beginning of a controlled nuclear chain reaction, signalling progress but not completion of the project.

Working of Fast Breeder Reactors

- Fast Breeder Reactors (FBRs) are significantly more efficient, with a fuel utilisation rate of around 10% or more.
- Unlike PHWRs, FBRs primarily use **plutonium as fuel** and do not rely on slowing down neutrons.
- The reactor core is surrounded by a blanket of **depleted uranium**. When fast neutrons strike this blanket, uranium is converted into plutonium, which can be reprocessed and reused as nuclear fuel.
- Plutonium-based fuel undergoes fission using fast neutrons, releasing more fast neutrons that continue the process.
- This creates a system where the reactor not only generates energy but also produces additional fuel, enhancing efficiency.

India's Three-Stage Nuclear Programme and FBRs

- India's nuclear programme, conceived by Homi Bhabha, is structured in **three stages** to achieve long-term energy security.
- In the first stage, **Pressurised Heavy Water Reactors (PHWRs)** use natural uranium to generate electricity while producing plutonium and depleted uranium as by-products.
- In the second stage, Fast Breeder Reactors (FBRs) utilise this plutonium and depleted uranium to generate more energy and produce additional plutonium.
- In the final stage, advanced reactors will use plutonium and thorium to produce electricity, leveraging India's abundant thorium reserves.

Challenges in Developing Fast Breeder Reactors

- **Technical Complexity and Delays** - Developing FBRs has proven far more difficult than anticipated. India's Prototype PFBR faced significant challenges during construction despite being designed and executed by specialised institutions.
- **Use of Liquid Sodium Coolant** - FBRs use liquid sodium as a coolant, which improves heat transfer and avoids the need for high pressure. However, sodium reacts violently with air and water, requiring perfectly sealed systems and strict leak detection, making operations complex and costly compared to water-cooled reactors.
  - Japan's Monju reactor suffered a sodium leak and fire, leading to eventual shutdown.
  - France's Superphénix reactor was closed due to technical problems and high costs.
  - Russia continues to operate a limited number of FBRs, showing technical feasibility.
- **Economic and Public Acceptance Issues** - Although technically feasible, FBRs are not yet economically viable and have struggled to gain public acceptance. High costs and safety concerns remain major barriers.
- **Need for Strong Safety and Oversight** - FBRs require rigorous monitoring, engineering precision, and a strong safety culture, making their successful operation dependent on both technological capability and institutional discipline.

India's Approach to Fast Breeder Reactors

- **Strategic Focus on Long-Term Fuel Security** - India's pursuit of FBRs is driven by its three-stage nuclear programme, which aims to ensure long-term energy security by efficiently utilising available nuclear resources.
- **State-Driven and Insulated Governance Structure** - India's nuclear sector is largely state-controlled, with the Department of Atomic Energy (DAE) reporting directly to the Prime Minister's Office.
- **Limited Accountability and Transparency Issues** - The insulated decision-making framework has reduced scrutiny. Projects have faced delays and cost overruns, with accountability diffused across agencies. The PFBR's cost rose from ₹3,500 crore to ₹6,800 crore, alongside multiple deadline extensions.

FOOD SAFETY AND STANDARDS AUTHORITY OF INDIA

- It has been established under the **Food Safety and Standards Act, 2006.**
- **Mandate:** FSSAI is responsible for **setting food standards, regulating the manufacture**, storage, distribution, sale, and import of food, and ensuring the availability of safe and **wholesome food for human consumption.**

- **Functions of Food Safety and Standards Authority of India**
  - **Standards Development:** It formulates standards for various food products, ensuring they are safe for consumption.
  - **Food Safety Management Systems:** It provides guidelines for businesses to implement effective food safety management practices.
  - **Licensing and Registration:** FSSAI manages the licensing process for food businesses, ensuring they comply with food safety regulations.
  - **Surveillance and Monitoring:** Regular inspections and audits are conducted to assess compliance with food safety standards.
  - **Consumer Awareness:** Initiatives to educate the public about food safety, hygiene, and nutrition are a key focus area.
  - **Accreditation:** The FSSAI is also responsible for the **accreditation of food testing laboratories** throughout India.
- **Nodal Ministry:** Ministry of Health and Family Welfare, Government of India.

MAKHANA

- It is also **known as Foxnut,** is the dried edible seed of the **prickly water lily or gorgon plant (Euryale ferox).**
- The edible part of the Makhana plant **consists of small, round seeds** that have an outer layer ranging from black to brown. This has led to it being referred to **as the 'Black Diamond.'**

- Makhana plant is considered as **native of South-East Asia and China**, but distributed to almost every part of the world.
- **Required climatic conditions**
    - It is grown in **stagnant perennial water bodies** like ponds, land depressions, oxbow lakes, swamps and ditches.
    - It is a plant of **tropical and subtropical climate.**
    - **Temperature:**200C to 350 C
    - **Annual rainfall:**100 cm to 250 cm
    - **Soil:** Smooth loamy soil
- In India it is mainly distributed in the states of **Bihar, West Bengal, Manipur, Tripura**, Assam, Jammu & Kashmir, Odisha, Rajasthan, Madhya Pradesh & Uttar Pradesh.
- **Bihar in India is the leading state** in its production and processing.
- Makhana is a product approved under the Union government's One District One Product scheme, under which subsidies are provided to food processors for branding, marketing, and developing infrastructure.
- **Benefits of Makhana**
    - It is a kind of hydrophyte used both as drug and food which exhibits much application and development prospect in the fields of medicine, food and economy.
    - Makhana is the seed of a cash aquatic crop, which was popularly used as herb and food in China. Makhana possessed high nutritional value and many medical and health protection effects.

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

- It is an **autonomous organisation** under the **Department of Agricultural Research and Education (DARE)**, Ministry of Agriculture and Farmers Welfare, Government of India.

- **Background:** It was established on 16 July, 1929 as a registered society under the **Societies Registration Act, 1860.**
- It was started in pursuance of the report of the **Royal Commission on Agriculture**
- It is the apex body for **coordinating, guiding, and managing** research and education in **agriculture, including horticulture, fisheries**, and animal sciences, throughout the country.
- It is responsible for guiding research institutes and universities in agriculture, horticulture, fisheries, and animal sciences.
- **Mandate:** ICAR's primary mandate focuses on the thematic areas of Crop Science, Horticultural Science, Natural Resource Management, Agricultural Engineering, Animal Science, Fisheries Science, Agricultural Education and Agricultural Extension.
- The ICAR has played a pioneering role in ushering in the Green Revolution and subsequent developments in agriculture in India through its research and technology development.
- It has played a major role in **promoting excellence in higher education in agriculture**.
- It is engaged in cutting-edge areas of science and technology development and its scientists are internationally acknowledged in their fields.
- **Headquarters:** New Delhi.

AROGYA VAN INITIATIVE

- It is a new initiative to **develop thematic medicinal tree plantations** on vacant land parcels **along the National Highways.**
- It aims to **enrich biodiversity along the National Highways** by introducing medicinal tree species that **support pollinators, birds and microfauna**, thereby strengthening ecosystem resilience.
    - In the first phase an action plan has been formulated covering **17 land parcels** along different National Highway projects in the states of Madhya

Pradesh, Haryana, Delhi-NCR, Andhra Pradesh, Gujarat, Karnataka, Odisha, Tamil Nadu, Rajasthan, Maharashtra and Chhattisgarh.

- Under this **tree species with established medicinal properties** have been identified and will be planted at land parcels as **per suitability to the respective agro-climatic zones.**
- **Priority:** Priority will be given to land parcels **near toll plazas, wayside amenities**, interchanges, cloverleaf junctions and other prominent stretches along National Highways
- **Nodal Ministry:** Ministry of Road Transport & Highways

NATIONAL QUANTUM MISSION

- It was launched by the **Department of Science & Technology** for a **period from 2023-24 to 2030-31.**
- It is aiming 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**
    - It is being implemented by **establishing four Thematic Hubs (T-Hubs)** across leading institutions in India and each T-Hub will follow the **Hub-Spoke-Spike model**
    - **The mission focuses on 4 key areas:**

Quantum Computing: Led by the Indian Institute of Science (IISc) Bengaluru

Quantum Communication: It is led by the Indian Institute of Technology (IIT), Madras in association with the Centre for Development of Telematics, New Delhi

Quantum Sensing & Metrology: It is spearheaded by the Indian Institute of Technology (IIT), Bombay

Quantum Materials & Devices: It is coordinated by the Indian Institute of Technology (IIT), Delhi.

US-IRAN TWO-WEEK CEASEFIRE

A ceasefire between the United States and Iran was announced by former US President Donald Trump shortly before his stated deadline, with Iran's Foreign Minister Seyed Abbas Araghchi agreeing soon after. The move followed a public appeal by Pakistan's Prime Minister Shehbaz Sharif to de-escalate tensions.

Coming 39 days into the conflict, the ceasefire marked a significant step back from escalation, especially after strong threats regarding Iran's energy infrastructure and the Strait of Hormuz, bringing temporary relief to the international community.

US-Iran Ceasefire: Key Takeaways

1. Trump Steps Back from Escalation

- US President Trump displayed strong brinkmanship through threats and aggressive rhetoric during the conflict, but gradually moved towards de-escalation with phased pauses in military action.

2. Iran's Strategic Leverage: Control of the Strait of Hormuz

- Iran's control over the Strait of Hormuz—through which nearly **one-fifth** of global energy flows pass—disrupted global oil markets, driving prices up despite the U.S. not directly depending on this route.
- Iran's reopening of the Strait for two weeks reflects a **temporary de-escalation**, creating space for negotiations while maintaining leverage over future developments.

3. Iran's Maximalist Peace Terms: Negotiation Challenges Ahead

- Iran has presented a **comprehensive 10-point plan**, including demands for non-aggression commitments, control over the Strait of Hormuz, acceptance of uranium enrichment, lifting of all sanctions, termination of UN resolutions, compensation, and US troop withdrawal.
- Key Iranian demands—especially **sanctions relief and non-aggression guarantees**—have remained consistent throughout earlier negotiations with US representatives.

4. Pakistan's Emerging Role as a Mediator in the Ceasefire

- Pakistan has significantly **elevated its diplomatic profile** by playing a central role in brokering the ceasefire between the United States and Iran.
- Islamabad is now seeking to **institutionalise this role** by hosting further negotiations, branding them as the "Islamabad Talks," and inviting both sides for continued dialogue.

5. Relief For the Region

- The 39-day conflict has had a devastating impact across the region, with the death toll exceeding 3,000, including heavy casualties in Iran, Lebanon, Gulf countries, Israel, and among US military personnel.
- In this context, the two-week ceasefire offers a crucial window for negotiations, with Gulf countries particularly seeking a **durable peace** to reduce economic disruption and restore regional stability.

Impact on India: Economic Strain and Strategic Relief

- **Energy Crisis and Economic Impact** - The conflict disrupted oil and gas supplies from the Gulf, on which India depends for about 60% of its energy needs, raising concerns about economic slowdown and growth stability.
- **Relief from Ceasefire and Strait Reopening** - The ceasefire and reopening of the Strait of Hormuz provide major relief, as India had managed to receive only a limited number of shipments during the conflict period.
- **Diplomatic Undercurrents** - While Pakistan's role as a mediator has drawn attention, India has officially welcomed the ceasefire and expressed hope for lasting peace, without acknowledging Pakistan's involvement.
- **Impact on Indian Citizens** - The conflict affected Indian nationals, with eight deaths reported and concerns for nearly one crore Indians in the Gulf, who contribute significantly to remittances.
- **Broader Strategic Concerns** - India highlighted the wider disruption to global energy supply and trade networks, emphasising the importance of free navigation through the Strait of Hormuz for economic stability.

EXERCISE CYCLONE 2026

- It is a joint special force exercise **held between India – Egypt.**
- It is the **fourth edition of this exercise.**
- It is an annual event conducted **alternatively in India and Egypt.**

Participating Forces: The Indian contingent, comprising personnel from Special Forces units, will train alongside their Egyptian counterparts in a realistic operational environment.

Aim: It aims to **enhance joint mission planning capabilities** and improve interoperability through the exchange of best practices in special operations.

- The participating troops will undertake a series of training activities focused on special operational tactics, **techniques and procedures in desert and semi-desert terrain.**
- The joint exercise will also facilitate mutual exchange of professional expertise and provide an opportunity to strengthen bonds of camaraderie.