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Daily Current Affairs

To The Point

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GS Paper 3 – Environment, Ecology

1 Guidelines for Setting Up Bio-Resource Centres (BRCs) under NMNF

Context: The **Ministry of Agriculture & Farmers' Welfare** has released detailed **guidelines** for the establishment of **Bio-Input Resource Centres (BRCs)** under the **National Mission on Natural Farming (NMNF)**. This move is aimed at accelerating the adoption of **natural and organic farming** practices across India.

What Are Bio-Input Resource Centres (BRCs)?

BRCs are envisioned as **cluster-level hubs** that will produce and supply **natural bio-inputs** tailored to local needs. These centres will also serve as **knowledge and training hubs**, empowering farmers with region-specific solutions for sustainable agriculture.

Financial Assistance & Support:

- Each BRC will receive a **financial support of 1 lakh**, disbursed in **two installments** of 50,000.
- Assistance is **only for operational costs**—not for sheds, land, or permanent infrastructure.
- The funds aim to ensure **cost-effective production and distribution** of bio-inputs to **small and marginal farmers**.

Eligibility & Implementation:

- BRCs must be managed by **entrepreneurial farmer groups** already practicing **natural farming**.
- Where such groups are not available, **State Natural Farming Cells** will onboard **interested farmers** willing to make the shift.
- Inputs produced must remain **affordable and accessible** to all farmers in the cluster.

Integration with Other Schemes:

The initiative will be aligned with major agricultural schemes, including:

- **Formation & Promotion of 10,000 Farmer Producer Organizations (FPOs)**
- **National Mission on Edible Oilseeds**
- **Mission Organic Value Chain Development for North Eastern Region (MOVCDNER)**
- **Paramparagat Krishi Vikas Yojana (PKVY)**

This **convergence model** ensures better resource utilization and wider reach.

Significance of BRCs under NMNF:

- Ensure **local availability of natural farming inputs**
- Promote **community-based models** to reduce input costs
- Encourage **eco-friendly agricultural practices**
- Serve as centres of **capacity building, innovation, and grassroots mobilization**
- Facilitate the **transition from chemical to natural inputs**, reducing soil and water degradation

About National Mission on Natural Farming (NMNF):

Feature	Details
Type	Centrally Sponsored Scheme (CSS)
Nodal Ministry	Ministry of Agriculture & Farmers' Welfare

Launch Date	**November 25, 2024**
Objective	Promote **nature-based, sustainable agriculture** and reduce dependency on synthetic inputs
Implementation Target	**15,000 Gram Panchayat clusters**, reaching **1 crore farmers** and covering **7.5 lakh hectares** within 2 years

Additional Insights:

- Natural farming techniques promoted include **Jeevamrit, Beejamrit, and Ghanjeevamrit**, rooted in traditional Indian practices.
- **India aims to become a global leader** in sustainable agriculture, targeting the reduction of chemical fertilizer use by **20-30%** in coming years.
- BRCs can also become **rural employment generators**, especially for youth interested in agribusiness and eco-entrepreneurship.

Conclusion:

The establishment of **Bio-Input Resource Centres** is a strategic and timely intervention to **transform India's agricultural landscape**. By ensuring the **affordable, localized production of bio-inputs** and empowering farmers through knowledge, the **NMNF** is paving the way for a **resilient, sustainable, and inclusive agricultural economy**.

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GS Paper 2 – International Relations

2 India-France Inter-Governmental Agreement on Rafale-M Jets for Indian Navy

Context: India has officially signed a **64,000 crore Inter-Governmental Agreement (IGA)** with **France** for the procurement of **26 Rafale-Marine (Rafale-M)** fighter jets. This deal is a **Government-to-Government (G2G)** arrangement, ensuring a direct and strategic defence partnership without intermediaries.

Key Highlights of the Rafale-M Agreement:

- **Total Aircraft**: 26 **Rafale-M** jets tailored for **carrier-based operations**.
- **Delivery Timeline**: Starts in **mid-2028**, with completion by **2030**.
- **Training Provisions**: Comprehensive training for **crew members in both France and India**.
- **Support for IAF Fleet**: The agreement also includes **spares and equipment** for the **existing Indian Air Force Rafale jets**.
- **Transfer of Technology (ToT)**:
    - Integration of **Astra BVR (Beyond Visual Range) missile**, an indigenous air-to-air missile.
    - **Establishment of a production facility** for **Rafale fuselages in India**.
    - Creation of **Maintenance, Repair & Overhaul (MRO)** infrastructure for **engines, avionics, and weapons systems**.

Boost to Indian Industry & Economy:

- Expected to generate **thousands of jobs**.
- Will benefit **numerous MSMEs** (Micro, Small & Medium Enterprises).
- Strengthens India's push for **self-reliance in defence manufacturing** under **'Make in India'** and **Atmanirbhar Bharat** initiatives.

Modernising the Indian Navy's Air Power:

- **Current Carriers**:
    - **INS Vikramaditya** (Russian-origin)
    - **INS Vikrant** (Indigenous; commissioned in 2022)
- **Current Fighter Fleet**: 45 **MiG-29K** aircraft
    - Facing **low availability** and **end-of-service-life issues**
- **New Acquisition Need**: Rafale-M chosen to address urgent carrier-based combat requirements.

Rationalising Fleet Strength:

- Initial plan: **54 jets**
- Revised to **26 jets** due to:
    - Development of **Twin Engine Deck-Based Fighter (TEDBF)** by **DRDO**
    - Aim to support **indigenous defence innovation**

Other Major Defence Procurement: MQ-9B Sea Guardians

- India will procure **31 MQ-9B HALE RPAS** (High Altitude Long Endurance Remotely Piloted Aircraft Systems) from the **United States**.
    - **15 for Navy**
    - **8 each** for the **Army** and **Air Force**
- Deliveries scheduled from **January 2029 to September 2030**.
- Enhances India's **maritime domain awareness** and **long-range surveillance capabilities**.

Strategic Significance:

- Strengthens the **India-France defence partnership**, one of the oldest and most trusted.
- Enhances India's ability to **project power in the Indo-Pacific region**.
- A critical step in preparing for **future naval warfare**, integrating **cutting-edge technology** and **multilateral partnerships**.

Did You Know?

- The **Rafale-M** is the **naval variant** of the combat-proven Rafale fighter, capable of operating from **short runways and aircraft carriers**.
- India becomes the **first country outside France** to operate both **Air Force and Navy variants** of the Rafale.
- The **TEDBF**, India's upcoming indigenous carrier jet, is expected to take its first flight by **2026** and be inducted by **2032**.

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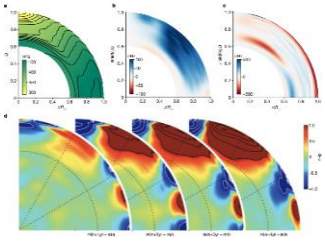
GS Paper 3 – Science & Technology

3 Exploring the Sun's Secrets: Breakthrough in Near-Surface Shear Layer (NSSL) Dynamics



Context: An **international team of solar physicists**, including experts from the **Indian Institute of Astrophysics (IIA)**, has successfully mapped the **plasma currents** within the **Sun's Near-Surface Shear Layer (NSSL)**. This breakthrough reveals flow patterns **tied closely to the Sun's 11-year sunspot cycle**, offering new insights into solar dynamics and magnetic activity.

What is the Near-Surface Shear Layer (NSSL)?

- The **NSSL** is a **highly dynamic zone** located **just beneath the Sun's visible surface**, extending to a depth of approximately **35,000 kilometers**.
- In this layer, the **Sun's angular velocity** (its rotation speed) **decreases sharply with radius**, creating a **rotational shear** that varies with **depth**, **latitude**, and the **Sun's magnetic cycle**.
- It serves as a **crucial interface** for solar magnetic and rotational processes, influencing **surface flows** and **subsurface convection**.

Key Findings from the Study:

- **Surface plasma flows** were observed to **converge toward sunspot latitudes**. However, midway through the NSSL, these flows **reverse direction**, **moving outward** to form **large-scale circulation cells**.
- These dynamic patterns are shaped by the **Sun's rotation** and the **Coriolis force**—the same force that governs **hurricanes on Earth**.
- Despite this dynamism, these localized flows **do not** account for the Sun's **large-scale zonal flows**, called **torsional oscillations**, suggesting the **existence of deeper, unexplored forces** within the solar interior.
- **3D velocity maps** confirmed the dual nature of these flows—**surface inflows and deeper outflows**—especially in sunspot-rich regions.

Scientific Methods & Instruments Used:

Researchers relied on **helioseismology**, a technique akin to "**ultrasound for the Sun**," which tracks **sound waves** generated within the Sun to probe its interior layers.

Data Sources:

- **NASA's Solar Dynamics Observatory (SDO)** – particularly the **Helioseismic and Magnetic Imager (HMI)**.
- **Global Oscillations Network Group (GONG)** – part of the **National Solar Observatory (NSO), USA**.
- These instruments provided **over a decade's worth of continuous data**, ensuring high precision and reliability of results.

Why This Matters:

- Understanding the NSSL is **vital to decoding solar activity cycles**, which affect **space weather**, **satellite communications**, and **power grid stability on Earth**.
- The study improves our models of **solar dynamo processes**, the mechanism responsible for generating the **Sun's magnetic field**.

- Findings may lead to better **predictions of solar flares and coronal mass ejections (CMEs)**, which have major implications for Earth's technological infrastructure.

Did You Know?

- The **Sun's magnetic activity** varies over an **11-year cycle**, influencing the number of **sunspots**, **solar flares**, and **geomagnetic storms**.
- Helioseismology has also been used to **detect sunquakes**, which are solar equivalents of earthquakes.
- The NSSL plays a **pivotal role in the solar dynamo theory**, which seeks to explain how the Sun **generates and sustains its magnetic field**.

Conclusion:

This landmark study in the **Near-Surface Shear Layer** deepens our understanding of the Sun's **plasma dynamics and internal structure**. With advanced observational tools and collaborative international efforts, scientists are inching closer to unraveling the mysteries of our closest star—enhancing not only **space science** but also safeguarding **Earth's technological future**.

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GS Paper 3 – Science and Technology & Environment

4 Breakthrough in Green Hydrogen Production by INST Scientists

Context: Scientists from the **Institute of Nano Science and Technology (INST), Mohali**, have introduced a **new approach to green hydrogen production** by enhancing the **efficiency of the Hydrogen Evolution Reaction (HER)**. Their innovative work revolves around **proton adsorption dynamics** on specially engineered catalyst surfaces, potentially revolutionizing the green hydrogen landscape.

Key Scientific Breakthrough:

Novel Catalyst Design:

- The team developed a **heterostructure catalyst** made by combining **Copper Tungsten Oxide ($CuWO_4$)** and **Copper Oxide (CuO)**.
- This combination forms a **p-n heterojunction**, utilizing the **Built-In Electric Field (BIEF)** effect, which creates an **asymmetric electronic environment** at the interface.

Role of BIEF in Hydrogen Evolution:

- The **BIEF** influences how **protons are adsorbed and released**, directly impacting the **efficiency of HER**, a core step in hydrogen production.
- The gradient in **Gibbs Free Energy (ΔG)** at the **CuO–$CuWO_4$ interface** helps:
  - **Enhance hydrogen adsorption** on the CuO side
  - **Promote desorption** on the $CuWO_4$ side

Unique Mechanism: Negative Cooperativity:

- This system exhibits **negative cooperativeity**, where **increased proton binding at one site reduces binding at adjacent sites**, encouraging **proton desorption**.
- This property is particularly beneficial for **alkaline water electrolysis**, where desorption is a **rate-limiting step**.

Understanding Green Hydrogen:

What is Green Hydrogen?

- **Green hydrogen** is generated via the **electrolysis of water** powered by **renewable energy sources** such as **solar, wind, or hydropower**.
- It emits **no greenhouse gases**, with **water vapour as the only by-product**, making it a **carbon-neutral** energy solution.

Comparison with Other Types of Hydrogen:

Type	Source	Emissions
Green Hydrogen	Renewable energy + water	**Zero emissions**
Grey Hydrogen	Natural gas (methane)	High CO_2 emissions
Blue Hydrogen	Natural gas + CCS*	Lower CO_2 (partial)

CCS: Carbon Capture and Storage

Major Green Hydrogen Production Methods:

1. Alkaline Electrolysis:

- **Most mature and cost-effective**
- Uses **KOH or NaOH** as electrolyte
- Requires **nickel or platinum electrodes**
- Suitable for **large-scale deployment**

2. Proton Exchange Membrane (PEM) Electrolysis:

- Offers **high efficiency and fast response**
- Operates at **low temperatures**
- Involves **expensive catalysts** (e.g., platinum, iridium)
- Ideal for **fluctuating renewable power inputs**

3. Solid Oxide Electrolysis (SOEC):

- Works at **high temperatures (700–1000°C)**
- Can co-electrolyze **H_2O and CO_2**
- Offers **high conversion efficiency**
- Requires **advanced materials** and **robust infrastructure**

Why This Matters for India and the World:

- India aims to become a **global hub for green hydrogen** under the **National Green Hydrogen Mission**.
- Efficient catalysts like the **CuO–$CuWO_4$ heterostructure** can help **lower the cost** of green hydrogen production.
- This breakthrough supports the goal of **decarbonizing energy**, **industry**, and **transportation**, critical sectors in achieving **net-zero emissions** by **2070**.

Did You Know?

- **One kilogram of green hydrogen** can power a **fuel cell vehicle for over 100 km**.
- **Green hydrogen** can also be used to **store surplus renewable energy** and convert it back into electricity when needed—acting as a **clean energy battery**.

GS Paper 2 – Education

5 Modernising India's Education System: Government's Push for 21st Century Readiness

Context: In a major policy thrust, **Prime Minister Narendra Modi** has reiterated the government's commitment to **modernising India's education system** to meet **21st-century challenges**. At the **YUGM Innovation Conclave** held at **Bharat Mandapam, New Delhi**, he outlined a vision for a **future-ready, inclusive, and globally competitive education ecosystem**.

Introduction: A New Era in Indian Education

India is undergoing a **paradigm shift in education**, led by the government's proactive approach to align academic systems with the **knowledge economy** and global standards. Central to this transformation is the **New Education Policy (NEP) 2020**, which seeks to prepare Indian youth with the **skills, mindset, and values** needed for global leadership in innovation.

Driving Forces Behind the Reform

The reforms are underpinned by a **trinity of development principles**:

- **Talent**: Unlocking the potential of India's vast youth population
- **Technology**: Integrating digital tools and platforms across the learning ecosystem
- **Temperament**: Fostering curiosity, critical thinking, and entrepreneurial spirit

The **NEP 2020**, constantly evolving to meet changing needs, serves as the cornerstone of this educational revolution.

Key Interventions & Infrastructure Overhaul:

National Curriculum Framework:

- Revamping the curriculum for **Classes 1–7**
- Emphasis on **conceptual clarity**, **experiential learning**, and **multilingual education**
- Teaching materials being developed in over **30 Indian languages**

Higher Education Expansion:

- Expansion of **IITs**, **AIIMS**, and other premier institutes
- Launch of **meditech and AI-integrated programs** to bridge industry-academia gaps
- Increased capacity for **STEM and innovation-based disciplines**

Digital Infrastructure: One Nation, One Platform

- Under **PM e-Vidya** and **DIKSHA**, the government is creating a **national digital education backbone**
- Content available in **30+ Indian and 7 foreign languages**, enabling **inclusive access**

Boosting Research, Innovation & Discovery:

Research Parks & R&D Cells:

- Rise in **Research Parks** from **3 in 2014** to **9 currently**, with **13 more planned**
- Nearly **6,000 higher education institutions** now host **R&D Cells**
- Encouragement for a **research-led academic environment**

Anusandhan National Research Foundation (ANRF):

- Proposed to become India's apex body for **cutting-edge research funding and policy**
- **Gross Expenditure on R&D (GERD)** doubled from ₹60,000 crore (2013–14) to ₹1.25 lakh crore

Lab-to-Market Ecosystem:

- Support for **startups, IP creation, and academic innovation hubs**
- Focus on **commercialising student-led innovations** and **industry collaboration**

Global Academic Engagement & Mobility:

- International expansion of Indian institutions:
  - **IIT Delhi** in **Abu Dhabi**
  - **IIT Madras** in **Tanzania**
  - Plans for **IIM Ahmedabad** in **Dubai**
- **Foreign universities** (e.g., from the US, UK, Australia) invited to set up campuses in India
- Enhanced **student exchange** and **faculty collaboration** with global institutions

Access to World-Class Knowledge:

One Nation, One Subscription:

- Nationwide academic access to **leading global research journals and publications**
- Designed to eliminate institutional paywalls and **democratise access to scientific literature**

India's AI-Driven Educational Future:

AI for Smart Learning:

- Integrated with the **IndiaAI Mission**, educational reforms include:
  - **Personalised learning platforms**
  - **Skill gap identification** through data analytics
  - **Adaptive learning modules** based on student performance

AI is expected to **transform pedagogy**, make learning **more inclusive**, and **enhance administrative efficiency** in educational institutions.

GS Paper 3 – Environmental Pollution & Degradation

6 Understanding the Urban Heat Island Effect

Context: A recent study reveals the **dual impact of the Urban Heat Island (UHI) effect**: While it **increases heat-related mortality**, it also **substantially reduces cold-related deaths**. In 2018, the global decline in **cold-related fatalities** was **4.4 times greater** than the rise in **heat-related deaths**, with cities like **Moscow** witnessing even larger differentials.

What is the Urban Heat Island (UHI) Effect?

An **Urban Heat Island (UHI)** refers to an **urban area** significantly warmer than its surrounding rural areas. This occurs because materials like **concrete** and **asphalt** absorb and retain heat more effectively than natural landscapes, making **cities** hotter. The UHI effect is most pronounced in **large, densely populated cities** like **New Delhi**, **New York**, **Paris**, and **London**.

Key Causes of UHI:

- **Impervious Surfaces**: Materials such as **asphalt**, **concrete**, and **steel** absorb heat during the day and release it slowly at night, trapping heat due to their **low albedo**.
- **Lack of Vegetation**: Limited **green cover** and **tree canopy** reduce **evapotranspiration**, cutting off natural cooling processes and increasing heat buildup in urban areas.
- **Anthropogenic Heat**: Human activities such as **vehicular emissions**, **industrial processes**, and **air conditioning** contribute excess heat, further raising urban temperatures.
- **Air Pollution & Soot**: **Black carbon** and other **particulate matter** absorb **solar radiation**, which exacerbates the UHI effect by raising ambient temperatures.
- **Urban Morphology**: The **design** of cities, with dense buildings, narrow streets, and poor airflow, creates an **urban canyon effect**, trapping heat within confined spaces. **Skyscrapers** and high-rises restrict airflow, intensifying heat accumulation.

Consequences of the Urban Heat Island Effect:

Increased Energy Demand:

- The rise in **local temperatures** due to UHI leads to higher **energy consumption** for **cooling** purposes, straining power grids and escalating **carbon emissions**. This positions **urban heat islands** as localized accelerators of **climate change**.

Deterioration of Air Quality:

- Higher temperatures amplify **ground-level ozone formation**, worsening **smog** and respiratory issues, making it harder to breathe in urban environments.

Heat-Related Health Risks:

- UHI intensifies the occurrence of **heat strokes**, **dehydration**, and **cardiovascular stress**, particularly in vulnerable groups such as the elderly, children, and those with pre-existing health conditions.

Strain on Water Resources:

- With higher temperatures, **evaporation rates** increase, reducing available **water resources** for consumption and **cooling** purposes.

Biodiversity Loss:

UHI negatively affects **native vegetation**, disrupts **ecosystems**, and poses a threat to **urban wildlife** due to excessive heat and the reduction of green spaces.

Solutions and Mitigation Strategies:

- **Increasing Green Cover**: Expanding **urban forests**, **green roofs**, and **vegetative walls** can help cool cities by enhancing **evapotranspiration** and providing shade.
- **Cool Roofs and Pavements**: Using reflective materials with **high albedo** for roofing and pavements can reduce heat absorption, helping lower temperatures.
- **Smart Urban Planning**: Designing cities with wider streets, more open spaces, and better **airflow** can help mitigate the **urban canyon effect** and enhance cooling.
- **Energy-Efficient Buildings**: Promoting **energy-efficient building designs** with natural cooling can significantly reduce the urban heat footprint.

The **Urban Heat Island (UHI) effect** highlights the urgent need for sustainable urban planning to combat the growing temperature disparity between cities and their rural surroundings. By taking proactive measures to reduce UHI effects, cities can improve quality of life, health, and environmental sustainability for their residents.

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