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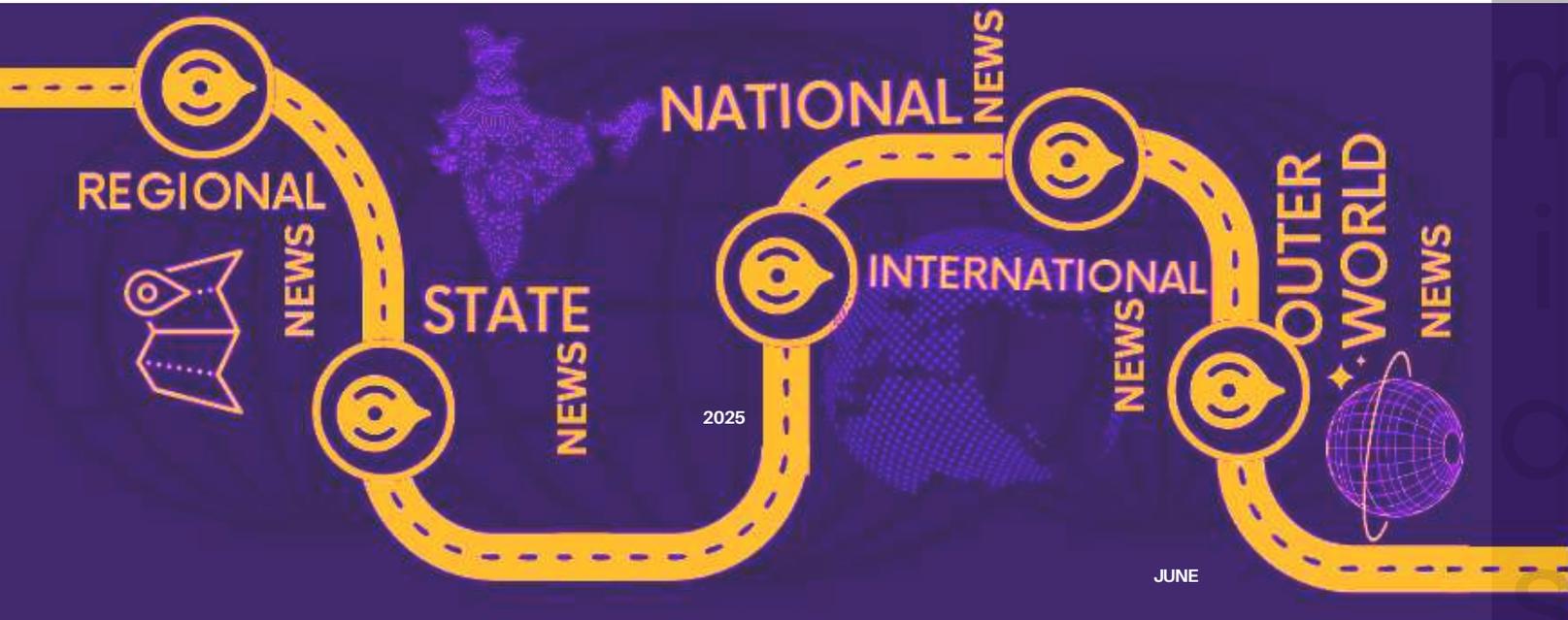
MUST READ!

- Right To Disconnect and Women's Work in the Digital Economy
- Parliamentary Privileges and Breach of Privilege in India
- India's Foreign Policy in 2025
- Digital Transformation of India's Dairy Sector
- Grasslands And Climate Governance
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- ANDHRA PRADESH AS A GLOBAL GREEN HUB
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February 2026 | EKAM IAS ACADEMY

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PREFACE

Welcome to our monthly current affairs magazine! We are thrilled to provide you with the latest information and updates on the most important events that happened in our country and around the world in the month of FEBRUARY 2026. Our magazine is designed to help you prepare for competitive examinations like UPSC and other State PSC Exams, and we hope that you will find it informative, engaging, and useful.

In this magazine, you will find a wide range of topics covering current affairs, including politics, economics, sports, science and technology, and many more. Our team of writers and editors work hard to bring you the most accurate and up-to-date information, so you can stay informed and prepared for any competitive exam. We understand that preparing for competitive exams can be a daunting task, but we are here to make it easier for you. Our magazine is designed to be easy to read and understand, with clear and concise articles that will help you stay on top of the latest news and events.

We believe that knowledge is power, and we are committed to helping you achieve your goals. Whether you are preparing for a government job, entrance exam, or any other competitive exam, our magazine will provide you with the information and insights you need to succeed.

Thank you for choosing our magazine, and we hope that you find it helpful and informative.

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ACKNOWLEDGMENTS

We extend our heartfelt gratitude and appreciation to the exceptional team of content developers who have played a pivotal role in shaping our UPSC Current Affairs Magazine. Your unwavering dedication, extensive research, and commitment to delivering high-quality content have been instrumental in making this publication a trusted resource for our readers.

Your relentless pursuit of current affairs, profound understanding of complex issues, and the ability to distil them into informative, concise, and engaging articles have set a benchmark in the field of competitive examination preparation.

We are proud to have a team that goes above and beyond, ensuring that our readers are well-informed and well-prepared for the UPSC examinations. Your exceptional contributions are the driving force behind our magazine's success.

Thank you for your hard work, expertise, and passion for delivering top-notch content. Your efforts have not only enriched our magazine but have also played a significant role in the educational journey of countless aspiring civil servants.

We look forward to continuing this remarkable journey of knowledge dissemination with your continued support and excellence.

With deep appreciation,

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POLITY AND GOVERNANCE

RIGHTS ISSUES

JUVENILITY AGE DEBATE & THE TRANSFER SYSTEM UNDER THE JJ ACT

SOURCE: TIMES OF INDIA

Why in News?

A **Private Member's Bill (Dec 2025)** proposed reducing the age for trying juveniles as adults in heinous offences from **16 to 14 years**.

This has reignited debate over the **transfer system** under the **Juvenile Justice (Care and Protection of Children) Act, 2015**.

About the Transfer System

- The juvenile justice system is rooted in **rehabilitative philosophy**, recognising children's evolving mental capacity.
- The **JJ Act, 2015**, enacted after public outrage over serious crimes, allowed juveniles aged **16–18 years** accused of **heinous offences** (minimum 7-year punishment) to be assessed for adult trial.
- The **Juvenile Justice Board (JJB)** conducts a **preliminary assessment** of mental and physical capacity, ability to understand consequences, and circumstances.
- Even when transferred, the child is sent to a **place of safety**, not an adult jail, and is reviewed again at **21 years**.

Consequences of Lowering the Age of Juvenility
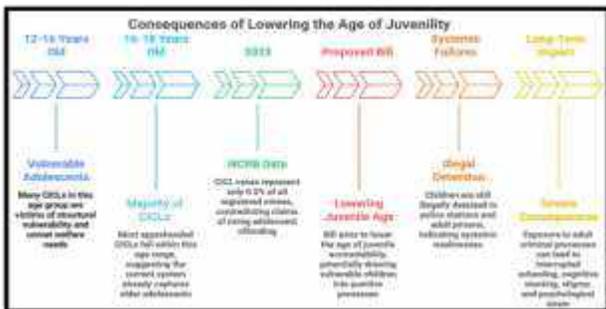
Arguments Supporting the Transfer System

Accountability for serious crimes

- Advocates argue that some adolescents possess sufficient maturity to understand the gravity of crimes such as murder or rape.
- Adult trials ensure punishment is not limited to the earlier **three-year reform cap**.

Deterrence rationale

- The possibility of adult punishment may discourage intentional misuse of juvenile protections in grave crimes.

Balancing victim rights

- It attempts to ensure **proportional justice** for victims while retaining safeguards for children.

Assessment safeguards

- Mandatory evaluation by JJB ensures case-by-case consideration rather than automatic transfer.

Limited punitive scope

- Death penalty and life imprisonment without release remain prohibited, keeping a partial reform focus.

Arguments Against the Transfer System

Weak evidence base

- There is **no conclusive research** proving adult trials reduce juvenile crime.

Scientific limitations

- No reliable tools exist to measure "adult-like" mental capacity in adolescents accurately.

Subjective decision-making

- JJB assessments vary widely due to absence of uniform national standards, causing **unequal outcomes**.

Developmental contradiction

- Neuroscience shows adolescents are still developing impulse control and risk assessment.

Shift toward punishment

- The model shifts focus from social background, trauma, and poverty to **criminal blame**.

Risk of age reduction

- Lowering the threshold to **14 years** may expose even more vulnerable children to the adult criminal system.

Data Perspective

- NCRB data shows children in conflict with law form **less than 1% of total cognizable crimes** in recent years.
- A significant proportion of such cases involve **petty or socio-economic offences**, not violent crime.
- This weakens the argument that stricter punishment is the primary solution.

Way Forward

Strengthen institutions instead of lowering age

- Improve child protection services, observation homes, and probation systems.

Evidence-based reforms

- Law changes should rely on **criminological and psychological research**, not public emotion.

Early intervention

- Focus on schooling, counselling, and community support to prevent entry into crime.

Address root causes

- Poverty, abuse, substance use, and family breakdown drive juvenile offending.

Invest in rehabilitation

- Skill training, mental health care, and family reintegration reduce repeat offences.

Ensure safeguards

- Prevent illegal detention of juveniles in police lock-ups or adult prisons.

Uphold child rights

- Follow the **best interest principle** under constitutional and international child rights law.

Conclusion

Reducing the age of juvenility prioritizes **punishment over reform** without strong evidence of deterrence. A child-centred system focused on **rehabilitation, institutional reform, and early support** offers a more just and sustainable solution.

RIGHT TO DISCONNECT AND WOMEN'S WORK IN THE DIGITAL ECONOMY

SOURCE: THE HINDU

Why in News?

Kerala has proposed the **Right to Disconnect Bill, 2025** to protect private employees from being compelled to respond to work communication after office hours.

What is the Right to Disconnect Bill?

- The Bill proposes a legal right for employees to **ignore work-related calls, emails, or messages** beyond official working hours.
- Employers cannot penalise workers for exercising this right.
- It applies mainly to the **private sector**, where digital overreach is common.
- If passed, Kerala would be the **first Indian state** to adopt such a law.

- Similar policies exist in **France, Spain, Italy, Germany, and Belgium**, where regulated work hours improved productivity and mental well-being.

Significance in the Indian Context

- Long workdays and digital connectivity are often normalised in India.
- The law can help address **burnout, stress disorders, and work–life imbalance**.
- Particularly beneficial for women balancing employment with **household and caregiving duties**.
- Reflects a shift toward recognising **mental health and labour dignity** as governance priorities.

Impact of Labour and Digital Reforms

Labour Code Reforms

- Allow women to work night shifts with safeguards, expanding access to better-paying jobs.
- Aim to remove legal barriers but social norms remain obstacles.

Digitalisation

- Rising internet penetration has enabled **remote work, freelancing, and online entrepreneurship**.
- Digital platforms offer flexibility and market access for women.

Gig and Platform Economy

- Provides income opportunities with flexible schedules.
- However, gig work often lacks **social security and stable income**.

Women Entrepreneurship

- Growth in women-led enterprises through e-commerce platforms.
- Still concentrated in small-scale informal ventures with limited credit access.

Key Challenges Faced by Women

Double Burden of Labour

- Work-from-home increases participation but merges office work with domestic chores.
- Women often perform professional duties alongside cooking, childcare, and elder care.

Burnout and Corporate Culture

- Post-pandemic work culture expects 24/7 digital presence.
- Cross-time-zone jobs disrupt sleep and health.
- Gender norms still assign primary care roles to women.

Digital Divide

- Benefits of digitalisation are uneven; many women lack **digital skills or autonomy**.

Why the Right to Disconnect Matters
- Reinforces the idea that **time off is a right**, not a privilege.
- Helps establish clear boundaries in remote and hybrid work models.
- May reduce stress-related productivity losses.
- Supports women by limiting expectations of round-the-clock professional engagement.

Way Forward
Complementary Structural Policies
- Affordable **childcare facilities and crèches**.
- **Paid parental leave** for both parents.
- Social security coverage for gig and informal workers.

Workplace Culture Reform
- Encourage output-based evaluation rather than hours online.
- Promote shared domestic responsibility through awareness campaigns.

Digital Inclusion
- Expand digital literacy and access for women in rural and low-income groups.

Legal Enforcement
- Clear guidelines and grievance mechanisms to prevent misuse by employers.

Conclusion
The Right to Disconnect recognises that **digital progress must not erode human well-being**. Combined with care support and gender-sensitive policies, it can help women achieve **balanced and dignified participation** in the workforce.

JUDICIARY

DISABILITY RIGHTS IN PRISONS: SUPREME COURT'S 2025 INTERVENTIONS

SOURCE: THE HINDU

Why in News?
In **2025**, the Supreme Court in *L. Muruganantham v. State of Tamil Nadu* and *Sathyan Naravoor v. Union of India* strengthened protections for **prisoners with disabilities**.

Background
- The **RPwD Act, 2016** recognises 21 categories of disabilities and mandates accessibility, non-discrimination, and reasonable accommodation.
- Prison rules historically focused on security, not disability inclusion.
- Disabled inmates frequently faced denial of **assistive devices, medical care, mobility support, and accessible toilets**.
- Social action litigation highlighted the **systemic neglect** of disabled prisoners.

Key Directives in the Muruganantham Judgement
Identification and Assessment
- Prisons must conduct **systematic screening** to identify inmates with disabilities and map their needs.

Healthcare and Support
- Mandated access to **medical treatment, physiotherapy, mental health services**, and personal caregivers.

Prison Manual Reforms
- Directed alignment of prison rules with the **RPwD Act** and accessibility norms.

Capacity Building
- Ordered **training and sensitisation** of prison officials on disability rights.

Monitoring Mechanisms
- Introduced **audits, inspections, and oversight committees** to track compliance.

Expansion through the Sathyan Naravoor Judgement
Nationwide Applicability
- Extended all Muruganantham safeguards to **every State and Union Territory**.

Grievance Redressal
- Ordered creation of accessible complaint systems for disabled inmates.

Education and Rehabilitation
- Encouraged **inclusive education, skill-building, and reintegration programmes**.

Family Access
- Improved visitation norms so families can assist inmates with disabilities.

Legal Accountability

- Clarified that **Section 89 of RPwD Act** applies to prison officials, making neglect punishable.

Constitutional and Jurisprudential Significance

Rights Survive Imprisonment

- Reinforces the principle from *Sunil Batra* that prisoners retain **fundamental rights**.

Article 14 – Equality

- Ensures **non-discrimination** and reasonable accommodation.

Article 21 – Dignity and Life

- Expands the meaning of **humane treatment** to include disability-sensitive care.

Constitutional Morality

- Courts filled legislative gaps to uphold **human dignity over administrative convenience**.

Social Justice Jurisprudence

- Continues India's tradition of **judicial activism for vulnerable groups**.

Implementation Challenges

- Chronic **prison overcrowding** and resource shortages.
- Limited budget allocations for accessibility upgrades.
- Variations in prison conditions across States.
- Resistance to change within prison bureaucracy.

Way Forward

Time-bound Compliance

- Prepare clear **Standard Operating Procedures (SOPs)** for disability inclusion.

Accessibility Audits

- Conduct periodic third-party audits of prison infrastructure.

Budget Support

- Allocate dedicated funds for ramps, assistive devices, and healthcare.

Training Programmes

- Institutionalise disability-rights training for prison staff.

Independent Monitoring

- Establish external oversight bodies and effective complaint systems.

Alternatives to Incarceration

- Consider **bail or community supervision** for severely disabled undertrials.

Conclusion

The 2025 Supreme Court rulings affirm that **disability cannot become a ground for double suffering** inside prisons.

Effective enforcement can transform prisons into spaces that uphold **dignity, equality, and constitutional values**.

GENDER JUSTICE, VICTIM DIGNITY AND INSTITUTIONAL ACCOUNTABILITY

SOURCE: INDIAN EXPRESS

Why in News?

The death of a young doctor in **Phaltan, Maharashtra**, has drawn attention to the gap between **legal safeguards** and **societal attitudes** in cases involving gender-based violence. The episode exposed failures in **institutional response** and the persistence of **public victim-blaming**.

Key Issues Highlighted

Administrative Inaction

- Allegations suggest that the victim's pleas for support were not adequately addressed.
- This reflects gaps in **preventive intervention**, counselling, and grievance redress mechanisms.

Secondary Victimisation

- Victims or their families often face **public character judgement** when seeking justice.
- Comments by public authorities about a victim's private life shift focus away from the alleged offence.

Patriarchal Attitudes

- Social perceptions still link a woman's personal life with credibility.
- Such thinking contradicts modern legal principles that recognise **consent and autonomy**.

Media Sensationalism

- Disclosure of personal information and dying statements in media adds trauma and may compromise investigations.

Legal Safeguards Available

Criminal Law (Amendment) Act, 2013

- Strengthened laws on sexual offences and aimed to eliminate **character-based questioning** in trials.

Bharatiya Sakshya Adhiniyam, 2023

- **Section 50**: Past sexual history cannot be used to infer consent.
- **Section 48**: Prohibits cross-examination about a victim's "general immoral character".

Bharatiya Nyaya Sanhita, 2023

- **Section 72**: Protects identity of sexual offence victims from disclosure.

These provisions establish that **a victim's private life is legally irrelevant** in determining guilt.

Important Supreme Court Principles

Testimony of Survivors

- Courts have affirmed that a victim's statement carries weight and should not be discredited based on moral assumptions.

Right to Dignity

- Judicial rulings emphasise that investigation and trial processes must avoid causing **further humiliation**.

Ban on Identity Disclosure

- The Supreme Court has directed that even indirect identification of survivors must be avoided to prevent stigma.

Condemnation of Victim-Blaming

- Courts describe intrusive questioning into personal history as adding "**insult to injury**".

Violations Observed in the Case

Public Commentary

- References to private communications of the victim amounted to **informal character assessment**, though such lines are barred in courtrooms.

Media Exposure

- Circulation of sensitive details may interfere with legal proceedings and cause distress to the family.

Restricted Access

- Lack of transparency in sharing investigation updates with the complainant's side deepens mistrust.

Institutional Responsibility

- When authorities themselves discuss personal aspects, it undermines the **spirit of victim protection laws**.

Broader Governance Concerns

- **Implementation gap** between progressive laws and ground-level practices.
- Lack of **gender-sensitive training** for officials.
- Weak coordination among police, medical, and legal services.
- Insufficient forensic and digital evidence infrastructure.

Way Forward

Institutional Sensitisation

- Train police, prosecutors, and administrative authorities in **trauma-informed approaches**.

Victim-Centric Investigation

- Prioritise dignity, confidentiality, and psychological support.

Stop Victim-Blaming Culture

- Public officials must adhere to constitutional values of **equality and respect**.

Strengthen Infrastructure

- Invest in forensic labs, digital evidence handling, and women-friendly police desks.

Transparency and Accountability

- Ensure families have proper access to legal updates and grievance redress.

Community Awareness

- Promote education on **consent, gender equality, and legal rights**.

Conclusion

The Phaltan episode shows that **laws alone cannot end injustice** without institutional sensitivity and societal change. Protecting a survivor's **dignity, privacy, and voice** is essential to achieving true gender justice.

EXECUTIVE

PARLIAMENTARY PRIVILEGES AND BREACH OF PRIVILEGE IN INDIA

SOURCE: THE HINDU

Why in News?

The **Lok Sabha Speaker** is examining a notice alleging **breach of privilege and contempt of the House** during debate on a recent Bill.

The episode has revived discussion on the **scope, limits, and accountability** of parliamentary privileges.

Meaning and Purpose of Parliamentary Privileges

- Privileges are **extraordinary protections** available only to legislative bodies.
- They are meant to secure **freedom of debate, institutional authority, and smooth conduct of proceedings**.
- These privileges extend to the **Attorney General** when participating in proceedings but not to the President.
- The core aim is to protect **legislative independence**, not personal advantage.

Types of Parliamentary Privileges

Individual Privileges of Members

- **Freedom of speech in Parliament** (Article 105) without fear of legal consequences.
- **Immunity from court proceedings** for votes or speeches made inside the House.

- **Protection for authorized publications** of parliamentary debates.
- **Freedom from arrest in civil cases** during session and a specified period around it.
- **Exemption from jury service and court attendance** when Parliament is in session.

Collective Privileges of the House

- Right to **regulate internal proceedings** and frame rules.
- Power to **punish for breach of privilege or contempt**.
- Right to **exclude strangers** and hold secret sittings.
- Authority to **publish or restrict publication** of debates.
- Power to **summon witnesses and demand documents**.

Parliamentary privileges

Sources of Privileges

- **Constitutional basis**: Articles **105 & 122** (Parliament) and **194 & 212** (State Legislatures).
- **Historical practice**: Privileges of the British House of Commons as of 1950.
- **Statutory support**: Code of Civil Procedure provisions on civil arrest immunity.
- **Parliamentary rules and conventions**.
- **Judicial interpretation** through Supreme Court rulings.

Breach of Privilege and Contempt of the House

Breach of Privilege

- Occurs when a specific privilege of the House or a member is violated.
- Can involve obstruction, intimidation, or misrepresentation.
- A **privilege motion** may be moved if a minister or member misleads the House.

Contempt of the House

- A broader concept covering any act that **lowers the dignity or obstructs functioning** of Parliament.
- Every breach is contempt, but contempt can exist even without breach of a specific privilege.

Comparative Perspective

- **UK**: Privileges derive from statute and convention.
- **Canada**: Clearly defined in constitutional and statutory law.
- **Australia**: Similar framework with codified guidance.

Reforms Needed

Broad Statutory Framework

- Define essential privileges while allowing flexibility.

Transparent Procedures

- Standardize steps and ensure **natural justice** in inquiries.

Ethics Enforcement

- Link privileges with a strong **Code of Conduct**.

Harmonious Interpretation

- Balance privileges with **fundamental rights**.

Public Accountability

- Greater disclosure of committee findings and actions.

Conclusion

Parliamentary privileges are vital for **legislative independence**, but must be exercised with **restraint and accountability**. Clear procedures and ethical use can balance institutional authority with **constitutional values and public trust**.

POLICIES/SCHEMES/ACTS/REPORTS/ COMMITTEES IN NEWS

VIKSIT BHARAT SHIKSHA ADHISHTHAN (VBSA) BILL, 2025

SOURCE: PIB

Why in News?

The **Viksit Bharat Shiksha Adhishthan (VBSA) Bill, 2025** was introduced in the Lok Sabha and referred to a **Joint Parliamentary Committee** during the Winter Session of Parliament. It seeks to **transform India's higher education regulatory framework** in line with the National Education Policy (NEP) 2020.

Key Features of the Bill

1. Creation of a Unified Regulatory Structure

- **Viksit Bharat Shiksha Adhishthan (Apex Body):** The central authority responsible for overall coordination, standard-setting, and system guidance.

- **Three Independent Councils:**
  - **Viniyaman Parishad (Regulatory Council):** Oversees regulation and ensures compliance with norms.
  - **Gunvatta Parishad (Accreditation Council):** An autonomous accreditation agency focusing on objective quality evaluation.
  - **Manak Parishad (Standards Council):** Defines minimum academic and institutional standards.

2. Repeal of Existing Regulatory Acts

- The Bill envisages the **repeal of UGC Act, AICTE Act, and NCTE Act**, bringing all HEIs under one regulatory umbrella for standard determination and quality governance.

3. Public Digital Disclosure

- Introduction of a **digital transparency platform** where institutions must publish data on infrastructure, faculty, finances, accreditation status, outcomes, etc., to promote accountability.

4. Penalties for Non-Compliance

- The Bill proposes **strict penalties** (e.g., fines, closure) for institutions operating without legal approval to curb unauthorized entities.

MINISTRY OF EDUCATION

Regulatory Reforms
Viksit Bharat Shiksha Adhishthan Bill, 2025

➤ Clear functional separation of Standard Setting, Regulation, and Accreditation

➤ Harmonised benchmarks for regulation to ensure uniform quality standards while allowing flexibility and diversity

➤ Objective, transparent, technology-enabled, faceless Single Window systems, open to public scrutiny

➤ Public disclosure-based, responsive, and minimalistic regulation to enable institutions to focus on academic excellence

➤ Transparent and robust accreditation framework to strengthen quality assurance mechanisms.

➤ Enhanced autonomy for well-performing HEIs

Objectives & Significance

1. Regulatory Consolidation

- Simplifies governance by eliminating multiple regulators and integrating processes through a **single cohesive framework**.

2. Institutional Autonomy & Excellence

- Encourages greater autonomy for high-performing HEIs to innovate, design curricula, and pursue research.

3. Transparency & Stakeholder Trust

- Enhances **data transparency** and informed decision-making by students, parents, employers, and policymakers.

4. Alignment with NEP 2020

- Supports NEP's goals of multidisciplinary education, seamless academic mobility, academic bank of credits, and credit transfers.

5. Global Competitiveness

- Adopts international best practices in accreditation and governance to improve India's positioning in global university rankings.

Contemporary Higher Education Challenges in India

Low Gross Enrolment Ratio (GER)

- GER in higher education stands around **28–28.4%**, significantly below the NEP target of **50% by 2035**. Achieving this requires **millions of additional enrollments** and expanded institutional capacity.

Research & Innovation Deficit

- India's **R&D spending (~0.7% of GDP)** remains low compared to global standards, affecting research quality and innovation output.
- Contribution of higher education to national research outputs is limited.

Employability & Industry Alignment

- Many graduates lack Industry 4.0 skills, resulting in **employability gaps** in technology and data-driven sectors.

Regulatory Complexity

- Overlapping approvals, inspections, and compliance norms distract institutions from focusing on pedagogy and quality.

Reforms Needed Beyond the Bill

- **Boost GER:** Expand online, distance, and hybrid learning to improve access for diverse learners.
- **Faculty & Research Investment:** Increase funding for research and faculty development.
- **Industry-Academia Linkages:** Align curricula with industry needs and emerging technologies.
- **Inclusion & Equity:** Target scholarships, outreach, and support systems for underrepresented groups.

Conclusion

The **VBSA Bill, 2025** seeks to replace fragmented control with a **single, transparent and standards-based system**, aligning higher education governance with the **NEP 2020 vision**. If implemented effectively, it can improve **quality, access, research output, and global credibility** of India's higher education ecosystem.

ELECTORAL TRUSTS AND POLITICAL FUNDING IN INDIA

Why in News?

In **2024–25**, electoral trusts donated about **₹3,811 crore** to political parties, a sharp rise after the Supreme Court struck down the **Electoral Bond Scheme**.

What are Electoral Trusts?

- Electoral trusts are **non-profit companies** formed under **Section 8 of the Companies Act, 2013**.
- They act as intermediaries, collecting donations and distributing them to **registered political parties**.
- Governed by the **Electoral Trusts Scheme, 2013**, Income Tax Act provisions, and company law norms.
- Supervised by the **CBDT** and disclosures are submitted to the **Election Commission of India (ECI)**.
- Donors can include **Indian citizens, companies, firms, and associations**, but foreign sources and anonymous contributors are barred.

How Do Electoral Trusts Function?

- Trusts must apply for **periodic renewal** and maintain Section 8 status.
- At least **95% of total donations** received in a year must be distributed to political parties.
- Contributions must be made through **banking channels**, with PAN details mandatory.
- Annual audited reports must list **donors and beneficiary parties**.
- Trust funds cannot be used for personal or member benefit.

Other Sources of Party Funding

- **Small cash donations** (below the legal threshold).
- **Membership fees, publications, and interest income**.
- **Unknown sources** still form a significant share of party income, raising transparency concerns.
- The **Electoral Bond Scheme** was invalidated by the Supreme Court in 2024 for violating the **citizens' right to information**.

Electoral Trusts vs Electoral Bonds

Aspect	Electoral Trusts	Electoral Bonds
Nature	Non-profit intermediaries	Financial instruments via banks
Transparency	Donor details reported	Donor anonymity
Legal status	Operational	Struck down
Regulation	Company law + scheme rules	Finance Act mechanism

Advantages of Electoral Trusts

- Provide a **structured legal route** for corporate and individual donations.
- Allow **tax benefits**, encouraging formal reporting.
- Reduce completely anonymous political funding.
- Corporate governance norms ensure **audit and compliance**.
- Restrict foreign contributions, preserving **sovereign integrity**.

Key Concerns

Limited Public Transparency

- Data filed with authorities is not easily accessible to citizens.

Corporate Concentration

- A few large trusts dominate, leading to **unequal influence**.

Political Dependence on Big Donors

- Heavy reliance on corporate funding may affect policy independence.

Democratic Imbalance

- Smaller parties may struggle to attract funds, affecting **level playing field**.

Indirect Corporate-Political Nexus

- Trusts can become channels for **policy influence through funding**.

Way Forward

Greater Disclosure

- Make trust reports publicly searchable and accessible.

Caps on Corporate Funding

- Introduce limits to avoid overconcentration of financial power.

Encourage Public Funding

- Explore state funding models to reduce corporate dependence.

Stronger Oversight

- ECI and tax authorities should conduct periodic compliance audits.

Level Playing Field

- Consider mechanisms to support smaller parties fairly.

Conclusion

Electoral trusts have emerged as a **key channel for political finance** after the end of electoral bonds. Ensuring **transparency, accountability, and fair competition** is essential to protect democratic integrity.

MALAYALAM LANGUAGE BILL, 2025 AND LANGUAGE POLITICS IN INDIA

SOURCE: THE HINDU

Why in News?

The **Kerala Legislative Assembly** has passed the **Malayalam Language Bill, 2025**, proposing Malayalam as the principal official language of the State.

What is the Malayalam Language Bill, 2025?

- The Bill formally declares **Malayalam as the sole official language** for most state functions.
- It expands the use of Malayalam across **administration, education, judiciary, commerce, and digital governance**.
- English, currently used alongside Malayalam, would see reduced functional prominence.
- The Bill states that implementation will remain subject to the **Constitution of India**.

Key Provisions

Education

- Malayalam to be the **mandatory first language** in government and aided schools up to Class 10.
- Students from linguistic minorities can continue studying in their mother tongue where facilities exist.
- Exemptions are proposed for students from other States or abroad in certain examinations.

Judiciary and Legislature

- Bills and Ordinances to be introduced in Malayalam.
- Court judgments and legal documents to be **translated in phases**.
- Central and State Acts in English to be made available in Malayalam.

Administration

- Official communication, notifications, and correspondence to be conducted in Malayalam.
- Linguistic minorities allowed to communicate with authorities in their own language in designated areas.

Digital Governance

- Development of **Malayalam-enabled digital tools and open-source software**.
- Integration of Malayalam in e-governance and IT systems.

Institutional Mechanism

- Creation of a **Malayalam Language Development Directorate**.

- Renaming of the official language department to focus on Malayalam promotion.

Reasons for Introduction

- Part of Kerala's long-standing effort to enhance the **status of Malayalam** in governance.
- An earlier 2015 attempt faced objections regarding minority rights and central laws.
- The new Bill claims to have addressed those concerns through constitutional safeguards.

Opposition and Concerns

Karnataka's Objections

- Concerns over Kannada-speaking minorities in **Kasaragod district**.
- Fear that compulsory Malayalam in schools may weaken minority language education.

Minority Rights Debate

- Critics argue that language compulsion could affect rights under **Articles 29 and 30** protecting minority culture and education.

Three-Language Formula

- Questions raised about compatibility with national education policies promoting multilingualism.

Way Forward

- Ensure phased and inclusive implementation with **consultation of minority groups**.
- Strengthen translation infrastructure in courts and administration.
- Maintain flexibility in education to protect multilingual learning.
- Promote Malayalam without undermining India's **linguistic diversity**.

Conclusion

The Bill represents Kerala's effort to strengthen **Malayalam's role in public life**. Its success will depend on balancing **regional identity with minority rights and constitutional principles**.

PRELIMS POINTERS IN NEWS

WOMANIYA INITIATIVE (GEM)

SOURCE: PIB

Why in News?

The **Government e-Marketplace (GeM)** has completed **seven years** of the **Womaniya initiative**, which promotes **women-led enterprises** in public procurement. The

milestone highlights progress toward **gender-inclusive entrepreneurship** through digital government markets.
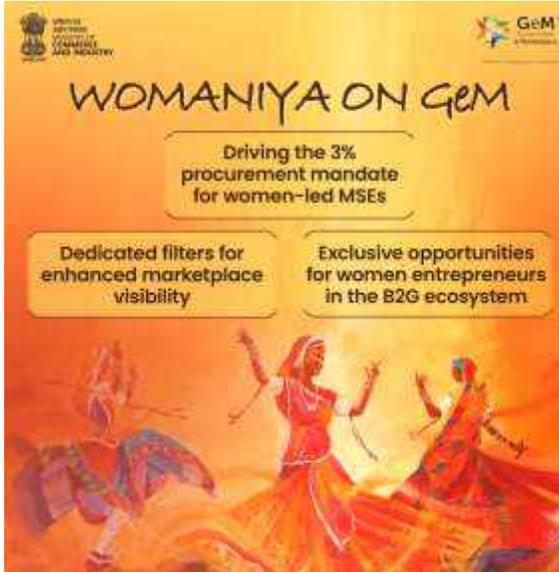
Background & Launch

- Launched on **14 January 2019**.
- Created to address **barriers faced by women entrepreneurs** in accessing government buyers.
- Operates through the **GeM portal**, India's national public procurement platform.

Objectives

- Expand **market access** for women-led businesses.
- Encourage **entrepreneurship and financial independence** among women.
- Reduce **gender gaps** in economic participation.
- Promote **transparent and direct engagement** with government buyers.

Key Features

- Enables **direct listing and selling** of goods and services by women entrepreneurs.
- Eliminates middlemen through a **fully digital interface**.
- Offers **ease of registration and onboarding** for MSEs and SHGs.
- Encourages procurement of **locally produced goods** under inclusive policies.
- Supports diverse sectors such as **handicrafts, textiles, food products, and services**.

Impact & Significance

- Strengthens **women's role in formal economic systems**.
- Enhances **income generation opportunities**.
- Contributes to **Skill India**, **Digital India**, and **Atmanirbhar Bharat** goals.
- Encourages **social inclusion and equitable development**.

About GeM Portal

- **Government e-Marketplace (GeM)** is India's **online public procurement platform**.
- Launched in **2016** by the **Ministry of Commerce & Industry**.
- Used by **Central and State Ministries, Departments, and PSUs**.
- Aims to ensure **efficiency, transparency, and speed** in procurement.

INDIRA GANDHI PEACE PRIZE

SOURCE: PIB

Why in News?
Graca Machel, noted Mozambican humanitarian and rights advocate, has been chosen for the **Indira Gandhi Prize for Peace, Disarmament and Development (2025)**. Her work in **child rights, women's empowerment, and post-conflict rehabilitation** has earned global recognition.

About the Indira Gandhi Peace Prize

- **Instituted**: **1986** in memory of former PM **Indira Gandhi**.
- **Awarding Body**: **Indira Gandhi Memorial Trust**.
- **Nature**: International award — open to **individuals or organisations** irrespective of nationality.
- **Award Components**:
  - ₹25 lakh cash prize
  - Citation

Objectives of the Prize
The award honours contributions in the following broad areas:

- Promotion of **international peace and disarmament**
- Encouraging **racial equality, harmony, and global goodwill**
- Strengthening **economic cooperation** and a **just international order**
- Supporting the **development of Global South nations**

- Ensuring that **science and knowledge** benefit humanity
- Expanding **freedom, human dignity, and social justice**

Significance of the Award

- Reinforces India's legacy in **non-alignment, peace diplomacy, and South–South cooperation**.
- Recognises work beyond politics — includes **humanitarian, social, and developmental contributions**.
- Highlights India's support for **inclusive global development** rather than power politics.

NPS VATSALYA SCHEME

SOURCE: THE HINDU

Why in News?

Pension Fund Regulatory and Development Authority has issued the **NPS Vatsalya Scheme Guidelines 2025** to operationalise a pension-linked savings plan for minors.

Eligibility & Account Structure

- Available to **Indian citizens**, including **NRI and OCI minors**.
- Account is opened in the **minor's name** and managed by a **parent or legal guardian**.
- Converts into a regular **NPS account** upon attaining adulthood.

Contribution Norms

- **Minimum initial and annual contribution:** ₹250.
- **No upper limit** on investment.
- Contributions may be made by **family members or well-wishers** as gifts.

Investment & Fund Management

- Guardian selects a **Pension Fund Manager (PFM)** registered with PFRDA.
- Funds are invested in a mix of **equity, corporate bonds, and government securities**, depending on the chosen option.
- Follows the **market-linked return model** of NPS.

Withdrawal Provisions

- **Partial withdrawals** allowed after **3 years** of account opening.
- Up to **25% of self-contributions** (excluding returns) permitted.
- Allowed for **education, medical needs, or disability support**.
- Withdrawal frequency is limited to ensure long-term savings discipline.

Objectives

- Encourage **financial literacy** and savings among youth.
- Build a **retirement corpus** over a longer compounding period.
- Support **future social security coverage**.

PANKHUDI PORTAL

SOURCE: THE HINDU

Why in News?

The **Ministry of Women and Child Development (MWCD)** has launched the **PANKHUDI portal** to streamline partnerships and CSR contributions.

Objectives

- Enhance **transparency and accountability** in CSR-supported projects.
- Encourage **multi-stakeholder collaboration**.
- Improve **resource mobilisation** for social sector schemes.
- Enable **result-oriented planning and monitoring**.

Key Features

- Operates as a **single-window digital system**.
- Connects **NGOs, corporate CSR wings, NRIs, private institutions, and government bodies**.
- Facilitates **proposal submission, approval, and tracking** online.

- Supports **cashless financial contributions** through secure digital modes.

Thematic Areas Covered

- **Nutrition and health** of women and children.
- **Early Childhood Care and Education (ECCE)**.
- **Child protection and rehabilitation** services.
- **Women's safety, empowerment, and welfare**.

Support to Flagship Schemes

The portal strengthens implementation of:

- **Mission Saksham Anganwadi & Poshan 2.0**
- **Mission Vatsalya**
- **Mission Shakti**

Operational Mechanism

- Registered contributors can browse projects aligned with government priorities.
- Clear **workflow-based approval system** ensures accountability.
- Digital records allow **monitoring of fund utilisation and impact**.

SPORTS AUTHORITY OF INDIA (SAI)

SOURCE: PIB

Why in News?

The **Sports Authority of India (SAI)** has organised a **Sports Sciences Workshop** for combat sports coaches in New Delhi.

Background

- Established in **1984** following the Asian Games legacy.
- Functions as a **registered society** funded by the Government of India.
- Works toward both **mass participation** and **elite performance**.

Objectives

- Promote **sports culture** nationwide.
- Identify and nurture **talented athletes**.
- Support **international-level performance**.
- Provide scientific, technical, and infrastructural backing.

Key Functions

- **Talent scouting** through grassroots programmes.
- Provision of **coaching, equipment, and sports kits**.
- Access to **modern infrastructure and sports science services**.
- Ensuring **competitive exposure**.

Major Schemes Implemented

- **National Centres of Excellence (NCOE)** – High-performance training hubs.
- **SAI Training Centres (STC)** – Grassroots development.
- **Extension Centres** – Outreach in remote areas.
- **National Sports Talent Contest (NSTC)** – Early talent identification.

Role in Sports Science

- Provides support in **physiology, nutrition, psychology, and injury management**.
- Workshops enhance **coach capacity** and athlete performance.
- Promotes evidence-based training methods.

Infrastructure Management

SAI maintains major sports venues in Delhi, including:

- Jawaharlal Nehru Stadium
- Indira Gandhi Sports Complex
- Major Dhyan Chand National Stadium
- Dr. S.P. Mukherjee Swimming Pool Complex
- Dr. Karni Singh Shooting Range

Significance

- Backbone of India's **sports ecosystem**.
- Contributes to **Olympic and international success**.
- Encourages **scientific training practices**.

MINISTRY OF PANCHAYATI RAJ IN 2025 YEAR END REVIEW

In 2025, the **Ministry of Panchayati Raj (MoPR)** intensified efforts to **revamp grassroots democracy** by adopting digital technologies, strengthening capacities, and promoting **women's and tribal leadership** in Panchayati Raj Institutions.

1. Key Achievements of the Ministry of Panchayati Raj in 2025

a) Strengthening Land Governance

- Under the **SVAMITVA Scheme**, over **2.75 crore property records** (property cards) were digitised for rural inhabited land, supporting secure land tenure and financial empowerment of villagers.
- **Drone surveys** covered approximately **3.28 lakh villages**, with some States/UTs achieving complete saturation of mapping.
- SVAMITVA received **international recognition** at the **World Bank Land Conference 2025** for innovative land governance.

b) Digital and Geospatial Governance

- **Enhanced Gram Panchayat Spatial Development Plans (GPSDP)** were piloted in **36 Gram Panchayats across 14 States**, integrating geospatial data into local planning.
- Platforms such as **Gram Manchitra** and **SVAMITVA GIS** helped visualise infrastructure, land use, and development needs.
- The vision of **One Nation One Map** strengthened unified spatial data use for better planning and monitoring.

c) AI and e-Governance for Transparency

- **SabhaSaar**, an **AI-powered summarisation tool** for **Gram Sabha meetings**, was rolled out, supporting **13 regional languages** through the **BHASHINI** initiative.
- The **eGramSwaraj platform** facilitated greater transparency in financial management with **Rs 34,573 crore** in online payments and real-time expenditure tracking.

d) Institutional Enhancements

- **1,638 Gram Panchayat Bhawans** (official buildings) were sanctioned to ensure functional offices, particularly for Panchayats with over 3,000 population.
- Leadership programmes at premier institutions like **IIMs, IITs and IRMA** boosted administrative and managerial skills of elected representatives and officials.

e) Women-Led Development

- **Sashakt Panchayat Netri Abhiyan** trained over **44,000 Women Elected Representatives**, enhancing their leadership roles.
- **Model Women-Friendly Gram Panchayats** were launched to prioritise gender-inclusive planning and governance.

f) Financial Self-Reliance

- The **Saksham Panchayat initiative** promoted **Own Source Revenue (OSR)** generation to reduce fiscal dependence on State and Central transfers.
- Over **1.10 lakh representatives and officials** received training on OSR mobilization using modules designed by **IIM Ahmedabad**, aiding **financial autonomy**.

g) Youth and Tribal Engagement

- **Model Youth Gram Sabhas (MYGS)** engaged students from **Jawahar Navodaya Vidyalayas (JNVs)** and **Eklavya Model Residential Schools (EMRS)** to encourage youth participation in local governance.

- To strengthen the **Panchayats (Extension to Scheduled Areas) Act, 1996 (PESA)**, more than **16,000 dedicated staff** were deployed across 10 PESA States.
- Cultural campaigns like **Hamari Parampara, Hamari Virasat** and the **PESA Mahotsav 2025** highlighted tribal heritage and participatory governance.

h) International Recognition

- The **Meri Panchayat m-Governance platform** won the **WSIS Champion Award 2025**, reinforcing India's leadership in digital governance and e-participation.

2. Primary Challenges Facing Panchayati Raj Institutions

a) Devolution Deficit

- Although the **73rd Amendment** mandates devolution of **29 subjects**, actual transfer of functions has declined, with key sectors like rural electrification and vocational training still under state control.
- PRIs' authority and accountability suffer due to limited functional autonomy.

b) Fiscal Dependence

- PRIs generate only about **1% of their revenue** from **local taxes and fees**.
- In **FY 2022–23**, own-tax revenue was a mere **Rs 737 crore** of the total **Rs 35,354 crore**, which undermines financial independence and planning capacity.

c) Socio-Cultural Barriers and Participation Gaps

- Patriarchal practices such as the **Sarpanch Pati phenomenon** dilute women's leadership roles in states like Uttar Pradesh and Bihar.
- **Gram Sabha participation** remains low, with turnout as little as 13%, and significant gender gaps in participation.

d) Administrative Encroachment

- The role of **Panchayat Secretaries** and overlapping bodies like **District Rural Development Agencies (DRDAs)** weakens elected representatives' decision-making authority.

e) Infrastructure and Capacity Constraints

- Many PRIs lack basic infrastructure, internet connectivity, and trained personnel, limiting effective planning and service delivery.
- The **Rashtriya Gram Swaraj Abhiyan (RGSA)** seeks to build capacity but its reach is uneven.

3. Reforms Needed to Strengthen PRIs

a) Full Devolution of Powers

- States must operationalise the **3Fs — Functions, Finances, and Functionaries** — across all subjects assigned under the **11th Schedule** by the Constitution.
- Clear activity mapping and elimination of functional overlaps are essential.

b) Fiscal Empowerment

- Expand **OSR avenues** through improved tax mechanisms and digital revenue management platforms like **Samarth Panchayat**.
- Explore **innovative financing tools** such as the **Social Stock Exchange** to channel funds for local development.

c) Capacity Building and Accountability

- Scale up training through **RGSA**, appoint trained full-time Panchayat secretaries, and institutionalise **social audits**.
- Strengthen **State Election Commissions** and grievance redress systems to promote accountability.

d) Technology and Social Inclusion

- Expand digital governance platforms (eGramSwaraj, SVAMITVA, Gram Manchitra) across all Gram Panchayats.
- Ensure meaningful women's leadership through legal safeguards and gender sensitisation.

e) Revitalising Citizen Engagement

- Gram Sabhas should be held regularly with mandatory reporting and supported by tools like **SabhaSaar** to boost participation.
- Youth programmes like **MYGS** can foster democratic values and civic responsibility.

Conclusion

In 2025, the Ministry of Panchayati Raj made significant strides in **digital governance, institutional strengthening, and inclusive empowerment**, enhancing the functioning of PRIs. Strengthening PRIs requires holistic reforms for more effective and participatory rural governance.

INTERNATIONAL RELATIONS

INDIA'S FOREIGN POLICY

INDIA'S FOREIGN POLICY IN 2025

SOURCE: THE HINDU

Why in News?

The year **2025** witnessed major global disruptions that tested **India's diplomatic adaptability** while also opening new strategic opportunities.

Diplomatic Challenges Faced by India

Strained India–US Relations

- Trade frictions emerged through **protectionist measures** and tariff barriers.
- Pressure over India's energy imports from Russia created strategic discomfort.
- Tightened **visa norms** affected Indian professionals and students.
- US engagement with Pakistan raised concerns about India's **counter-terrorism position**.

Regional Instability

- **India–Pakistan tensions** increased after terror incidents and military signalling.
- Political unrest in **Nepal** and governance instability in **Bangladesh** generated uncertainty and anti-India narratives.
- Neighbourhood instability increased India's security responsibilities.

West Asian Turbulence

- Conflicts in West Asia complicated India's energy security and diaspora safety.
- Connectivity initiatives and trade corridors slowed due to geopolitical tensions.

Rise of Global Right-Wing Politics

- Increasing **nationalist and inward policies** across countries weakened multilateral cooperation.
- Immigration restrictions and job competition affected Indian migrants.

Energy–Climate Policy Dilemma

- Fluctuating oil prices created pressure on India's energy transition plans.
- Balancing **development needs** with **climate commitments** became harder.

India's Diplomatic Successes

Reset in India–Canada Relations

- Diplomatic engagement restored representation, visas, and cooperation.
- Demonstrated India's ability to **stabilize strained partnerships**.

Engagement with Afghanistan

- India reopened channels with the Taliban government for humanitarian and security interests.
- Strategy aimed at maintaining **regional leverage** and limiting Pakistan's influence.

Rapprochement with China

- Limited normalization steps like visa restoration and data sharing resumed.
- Dialogue reduced tensions while maintaining border vigilance.

Strengthened Neighbourhood Partnerships

- India supported **Sri Lanka, Bhutan, and Maldives** through aid, connectivity, and disaster response.
- Reinforced India's role as a **reliable first responder**.

Implications for India

Reduced Strategic Predictability

- Overdependence on any major power proved risky, strengthening India's **multipolar diplomacy**.

Cost of Strategic Autonomy

- Balancing global blocs involved economic and political costs, emphasizing need for **self-reliance**.

Shift Toward Pragmatism

- Engagement decisions were guided by **national interest**, not ideology.

Foreign Policy's Domestic Impact

- Visa restrictions, energy prices, and trade shifts directly influenced India's economy and public sentiment.

Security Pressures

- Chinese regional activities and Pakistan's posture increased India's **two-front security concerns**.

Way Forward

Promote Issue-Based Partnerships

- Work with the US and Quad on **technology, maritime security, and AI**, while isolating disagreements.

Strengthen Ties with Europe

- Conclude **trade agreements** and collaborate on green technology and supply chains.

Balanced China Policy

- Continue dialogue and border stability while competing in economic and technological domains.

Neighbourhood Stability Focus

- Prioritize political outreach, development assistance, and crisis management in the region.

Global Agenda Leadership

- Lead discussions on **AI governance, climate justice, and connectivity corridors**.

Enhance Domestic Resilience

- Build **defence self-reliance**, semiconductor capacity, and diversified trade partnerships.

Conclusion

India's foreign policy in 2025 reflects a move toward **flexible and realistic diplomacy** in a fragmented world.

Strengthening **domestic capacity and diversified partnerships** will be crucial to safeguard India's long-term strategic interests.

INDIA RELATIONS WITH MAJOR NATIONS

INDIA–EUROPEAN UNION RELATIONS

SOURCE: THE HINDU

Why in News?

India and the **European Union (EU)** are intensifying engagement, with trade crossing **$130 billion** and negotiations on a **Free Trade Agreement (FTA)** nearing completion.

Major Pillars of India–EU Cooperation

Trade and Economic Engagement

- The EU is among India's **top trading partners** in goods and services.
- Services trade has expanded steadily, especially in **IT and business services**.
- The proposed FTA seeks to deepen **supply chain integration** and attract investment.
- The **Trade and Technology Council** promotes cooperation in digital and industrial sectors.
- The EU remains a key source of **foreign investment and technology**.

Strategic and Security Cooperation

- Dialogue on establishing a **Security and Defence Partnership**.
- Naval exercises and maritime cooperation enhance security in the **Indian Ocean**.
- Regular consultations address global security challenges.
- Defence industry collaboration encourages research and manufacturing ties.

Climate and Clean Energy

- The **Clean Energy and Climate Partnership** supports renewable energy and efficiency.
- Cooperation includes **green hydrogen, sustainable infrastructure, and climate finance**.
- Joint initiatives promote innovation in environmental technologies.

Connectivity and Infrastructure

- The **Connectivity Partnership** focuses on sustainable transport, digital networks, and energy links.
- Trilateral cooperation in third countries supports development projects.
- Participation in trans-regional corridors strengthens integration.

Science, Technology, and Space

- Joint research under scientific agreements and European programmes.
- Cooperation in space missions, satellite systems, and navigation.
- Institutional platforms enable future-oriented technology collaboration.

Migration and People-to-People Ties

- Frameworks facilitate **legal migration and mobility**.
- A large Indian diaspora strengthens socio-economic links.
- Educational exchanges and scholarships deepen academic cooperation.

Key Challenges in the Partnership and FTA

Rising Regulatory Barriers

- EU environmental and technical rules increase compliance costs for exporters.

Carbon Border Adjustment Mechanism

- Carbon-linked charges affect competitiveness of Indian energy-intensive exports.

Deforestation Regulation

- Strict traceability norms pose challenges for small agricultural producers.

Corporate Sustainability Rules

- Supply-chain due diligence requirements raise data security and cost concerns.

Local Content Policies

- EU industrial policies may reduce opportunities for non-EU suppliers.

Limited Tariff Gains

- Many Indian products already face low tariffs; further gains may be modest.

MSME Constraints

- Smaller firms struggle with certification and standards compliance.

Institutional Gaps

- Domestic testing, certification, and sustainability reporting systems need strengthening.

Way Forward

Enhance Regulatory Dialogue

- Negotiate **mutual recognition** of standards.
- Establish permanent technical working groups.

Address Climate-Related Trade Measures

- Seek transitional arrangements and recognition of India's climate efforts. Develop domestic carbon markets and green certification.

Build Compliance Capacity

- Modernise laboratories and digital traceability systems.
- Provide exporter training and institutional support.

Support MSMEs

- Offer financial aid and technical assistance.
- Expand export facilitation services.

Ensure Balanced FTA Provisions

- Include safeguard clauses and phased implementation.
- Ensure fair dispute settlement mechanisms.

Promote Technology Partnerships

- Encourage joint ventures in **renewables, EVs, and clean industry**.
- Use the Trade and Technology Council for technology exchange.

Strengthen Domestic Policy Frameworks

- Align sustainability reporting with global norms.
- Improve coordination and policy stability.

Leverage Strategic Diplomacy

- Use high-level engagement to resolve trade disputes.
- Deepen cooperation in Indo-Pacific and global forums.

Conclusion

India–EU ties are expanding across **trade, technology, climate, and security** domains. Overcoming regulatory and compliance challenges through cooperation and reforms will ensure a **balanced and resilient partnership**.

INDIA RELATIONS WITH OTHER NATIONS

INDIA–NEW ZEALAND FREE TRADE AGREEMENT (FTA)

SOURCE: THE HINDU

Why in News?

India and **New Zealand** have concluded negotiations for a comprehensive **Free Trade Agreement (FTA)**. The deal promises **full duty-free access for Indian exports** and significant long-term **investment commitments**.

Key Highlights of the Agreement

Trade Liberalisation

- New Zealand will eliminate customs duties on **all Indian goods exports**.
- India will gradually reduce tariffs on a large share of New Zealand's products, covering most of its export value.
- Sensitive sectors like **dairy and certain farm products** are excluded to protect Indian producers.

Investment Commitments

- New Zealand has indicated long-term investment support for India over the next decade and beyond.
- Provisions include mechanisms to review commitments if investments do not materialise.

Mobility and Services

- Expanded access for Indian professionals, students, and skilled workers.
- Opportunities across numerous services sectors including **IT, engineering, healthcare, hospitality, and education**.

- Provisions for student work rights and extended post-study employment.

Support for Traditional Knowledge

- Cooperation in fields such as **Ayurveda, yoga, and wellness-related services**.

MSME and Employment Focus

- Labour-intensive industries like **textiles, leather, gems, engineering goods, and processed foods** expected to benefit.

India–New Zealand Free Trade Agreement 2025: A New Era for Trade, Agriculture & Logistics

Faster routes and local payments reduce dependency, cut delays, and bring clarity in a volatile global market.

Significance of the FTA

Trade Diversification

- Reduces India's reliance on a limited set of markets and strengthens links in the Pacific region.

Strategic Economic Engagement

- Enhances India's economic presence among developed partners and builds long-term cooperation frameworks.

Export Competitiveness

- Duty-free access improves competitiveness for Indian manufacturing and services exports.

Managed Liberalisation

- Gradual tariff reduction and safeguards allow domestic industries time to adapt.

About Free Trade Agreements

- FTAs aim to reduce or remove trade barriers across most goods and services.
- They also address investment, standards, and regulatory cooperation.
- Modern FTAs increasingly include digital trade, sustainability, and intellectual property issues.

Challenges Linked to India's FTAs

Pressure on Domestic Industry

- Imports from advanced partners may affect MSMEs and agriculture.

Limited Gains in Services

- Mobility barriers and professional recognition issues can restrict services benefits.

Non-Tariff Barriers

- Technical standards and certification requirements may limit export gains.

Policy Space Concerns

- Provisions on investment and intellectual property may influence domestic regulations.

Strategies for Effective FTA Outcomes

Careful Negotiation

- Link goods concessions to gains in services and digital trade.
- Maintain strong safeguards for sensitive sectors.

Strengthen Competitiveness

- Improve logistics, infrastructure, and manufacturing capability.
- Support industries through technology upgrades and skills development.

Address Non-Tariff Barriers

- Negotiate mutual recognition of standards and transparent procedures.

Leverage New-Age Trade

- Promote digital trade, green technology cooperation, and sustainable value chains.

Conclusion

The India–New Zealand FTA enhances **trade, investment, and services cooperation** while protecting sensitive sectors. Its success will depend on **domestic preparedness and effective implementation** to ensure balanced benefits.

REGIONAL AND GLOBAL GROUPINGS

PAX SILICA SUMMIT, RARE EARTHS AND INDIA'S STRATEGIC CHOICES

SOURCE: THE HINDU

Why in News?

The **Pax Silica Summit (2025)** highlighted global efforts to secure **semiconductor, AI, and rare earth element (REE) supply chains**.

It reflects growing concerns over **China's dominance** and the need for resilient technology ecosystems.

What is the Pax Silica Summit?

- Convened in **2025** in Washington D.C.
- Focuses on safeguarding supply chains for **critical minerals, chips, and AI systems**.
- The term combines **"Pax" (peace)** and **"Silica" (chip material)**, symbolising technology-driven stability.

- The declaration promotes **trusted digital infrastructure** and reduced dependence on coercive suppliers.
- Participants include the U.S., Japan, Australia, European partners, and other advanced economies.
- India was not part of the inaugural group.
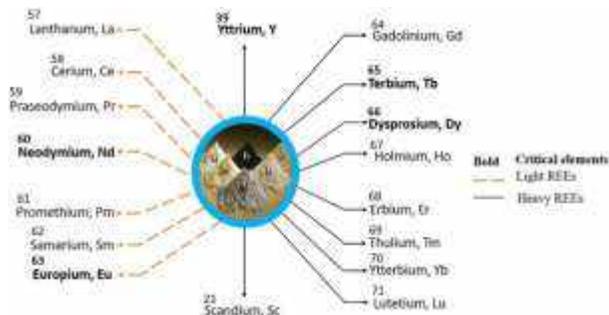
China's Dominance in Rare Earths

- China controls a major share of **REE mining, processing, and magnet production**.
- It has used export controls and licensing to influence global markets.
- Supply restrictions have affected industries such as **automobiles, electronics, and defence** worldwide.
- Such dominance creates vulnerability for countries dependent on imports.

Why It Matters for India

- India has faced disruptions in imports of **rare-earth magnets**, impacting manufacturing.
- Dependence on a single source exposes India to geopolitical risks.
- The pandemic highlighted the dangers of **concentrated supply chains**.
- India participates in initiatives like the **Quad and Supply Chain Resilience frameworks**, but diversification remains incomplete.

Strengths India Brings to a Technology Coalition

Digital and AI Ecosystem

- Rapidly expanding digital infrastructure and a growing AI market.

Policy Initiatives

- National missions to boost **semiconductor fabrication and AI innovation**.

Private Investment

- Indian firms and foreign companies investing in chip assembly and design.

International Collaboration

- Partnerships with Japan, Israel, and others to strengthen supply chains.

Human Capital

- Large pool of skilled engineers and technology professionals.

Challenges India Must Navigate

Developing Economy Status

- Expectations from advanced economies may not align with India's development needs.

Strategic Autonomy

- Participation in exclusive blocs could constrain independent foreign policy choices.

Nascent Manufacturing Base

- India's semiconductor ecosystem is still developing compared to established players.

Policy Differences

- Domestic protection measures may conflict with partners' trade preferences.

Geopolitical Implications

- Two parallel technology supply systems may emerge: one centred on China and another around alternative coalitions.
- Countries will balance economic interests with security concerns.
- India must avoid overdependence on any single bloc.

Way Forward

- Diversify sources of **critical minerals** and invest in domestic processing.
- Strengthen R&D and manufacturing capabilities in semiconductors.
- Engage in multilateral technology forums while preserving autonomy.
- Promote international cooperation in **ethical AI and resilient supply chains**.

Conclusion

Control over **critical minerals and chip technologies** is becoming central to global power dynamics. India must balance **economic opportunities with strategic independence** while building resilient supply networks.

GLOBAL ISSUES

GEOPOLITICAL IMPLICATIONS OF U.S. CONTROL OVER GREENLAND

SOURCE: INDIAN EXPRESS

Why in News?

Recent discussions about increased American control over **Greenland**, an autonomous territory under Denmark, have triggered global strategic debate.

Impact on NATO

- NATO is built on **collective defence and respect for sovereignty**.
- A forced takeover could create an unprecedented dispute between alliance members.
- Such internal tensions would weaken trust and coordination.
- NATO's credibility as a security institution could decline, affecting its deterrence capacity.

Strategic Benefits for Russia and China

- Divisions within NATO would benefit Russia by reducing pressure in Europe and the Arctic.
- China has expanded economic and strategic engagement in the Arctic.
- Cooperation between Russia and China in northern regions could gain momentum if Western unity weakens.

Existing U.S. Presence

- The United States already has military access under a defence arrangement with Denmark.
- Facilities in Greenland can be used or expanded without altering sovereignty.
- Therefore, full territorial control is not essential for U.S. strategic interests.

Domestic Drivers in the U.S.

- Greenland's reserves of **rare earth minerals** and strategic resources attract economic interest.
- Some policymakers view the territory as valuable for long-term commercial and security planning.
- Strategic choices may thus reflect a mix of **security and economic considerations**.

Implications for Canada

- U.S. control could change the Arctic security balance near Canada.
- Canada may feel the need to enhance defence readiness and Arctic surveillance.
- This could alter Canada's traditionally moderate security posture.

Risk of Nuclear Proliferation

- Weakening of alliance confidence may push countries to seek independent deterrence.
- European and Asian states could reconsider reliance on collective security.
- Such trends would undermine global non-proliferation efforts and increase instability.

Key Challenges

Alliance Fragmentation

- Internal disputes may weaken NATO's unity and collective credibility.

Legal and Diplomatic Disputes

- Changes in territorial control would raise questions under international law.

Arctic Militarisation

- Increased military activity in the Arctic could heighten confrontation risks.

Arms Race Concerns

- States may expand defence capabilities, raising tensions and costs.

Marginalisation of Smaller Actors

- Denmark and Greenland's autonomy could be overshadowed by major power politics.

Way Forward

Diplomatic Engagement

- Continuous dialogue among NATO members and Arctic stakeholders is essential.

Respect for International Law

- Sovereignty and territorial integrity must guide state behaviour.

Strengthen NATO Consultation

- Internal mechanisms should address disputes before escalation.

Cooperative Arctic Governance

- Multilateral institutions should promote sustainable and peaceful Arctic use.

Confidence-Building Measures

- Transparency in military activities can reduce suspicion.

Support Non-Proliferation

- Major powers must reinforce commitments to nuclear restraint.

Conclusion

Any unilateral control over Greenland could disrupt **alliance unity, Arctic stability, and global security norms**. Long-term peace depends on **diplomacy, cooperation, and respect for sovereignty**.

U.S. WITHDRAWAL FROM INTERNATIONAL SOLAR ALLIANCE

Why in News?

The United States has announced withdrawal from several global bodies, including the **International Solar Alliance (ISA)**.

What is the International Solar Alliance?

- Founded in **2015** with headquarters in India.
- Focuses on making **solar energy affordable and widely accessible** in tropical countries.
- Works mainly with developing nations in **Africa, Asia, and island states**.
- Functions as a platform for **South–South cooperation**.

Core Functions of ISA

The Alliance supports countries by:

- Facilitating access to **low-cost financing**.
- Reducing risks for private investors.
- Assisting in **policy design and regulatory frameworks**.
- Conducting training and capacity-building programmes.
- Promoting deployment of solar technologies.

Role of the U.S. in ISA

- The U.S. joined in **2021**.
- Its financial share was small, around **1% of total ISA funding**.
- Participation had more symbolic than operational importance.

Impact of U.S. Exit

Financial and Operational Impact

- Minimal effect, as funding from the U.S. was not central to ISA activities.
- Ongoing projects, training, and technical programmes continue unaffected.

Implications for India's Solar Sector

- No direct disruption to domestic solar expansion.
- India has expanded manufacturing capacity in **modules and solar cells**.
- Solar projects depend on domestic demand and long-term agreements, not ISA membership of specific countries.
- Consumer tariffs and project costs remain unaffected.

Global Supply Chain Context

- China remains a dominant producer of solar components globally.
- India continues to import some photovoltaic equipment.
- The U.S. exit does not change India's import dependence or pricing.

Investment and Employment Outlook

- Solar investments remain strong due to rising energy needs.
- Jobs in manufacturing, installation, and maintenance are secure.
- Potential opportunity: Indian firms could expand exports if global supply chains diversify.

Where the Risks Lie

- Developing countries in Africa and island states may face difficulties in mobilising climate finance.
- Slower approvals and cautious lenders could delay projects.
- Indian firms operating abroad may feel indirect effects.

Implications for India's Climate Diplomacy

- ISA is central to India's **climate leadership in the Global South**.
- The exit increases India's responsibility to sustain momentum and mobilise partnerships.
- India retains strategic leadership despite the absence of one major partner.

Way Forward

- Strengthen partnerships with other member countries and climate funds.
- Expand domestic solar manufacturing and innovation.
- Use ISA to promote energy access and diplomatic engagement simultaneously.
- Encourage private sector participation and diversified funding sources.

Conclusion

The U.S. withdrawal has **limited operational impact** but highlights challenges to global climate cooperation. India's

strong domestic capacity and leadership in ISA position it to **navigate this shift and sustain renewable momentum**.

U.S.– VENEZUELA TENSIONS AND GLOBAL OIL GEOPOLITICS

SOURCE: THE HINDU

Why in News?

Recent developments in **U.S.–Venezuela relations**, including U.S. actions targeting Venezuelan oil shipments and renewed statements on control over energy resources, have drawn global attention.

Nature of the Recent U.S.–Venezuela Tensions

- The U.S. has tightened enforcement of **oil-related sanctions**, targeting tankers and shipping networks linked to Venezuela.
- Maritime interceptions and monitoring operations in the Caribbean reflect an effort to curb sanctioned oil flows.
- Washington has signalled a desire to reshape Venezuela's oil sector, linking energy policy with political objectives.
- These developments show that energy resources remain a tool of **strategic influence**.

Status of Venezuela's Oil Sector

- Venezuela holds over **300 billion barrels** of proven reserves.
- Current production is about **1 million barrels per day**, a small share of global supply.
- Low output stems from:
    - **Economic collapse and underinvestment**
    - **Aging infrastructure**
    - **U.S. sanctions restricting technology and finance**

Global Energy Market Implications

If Sanctions Ease

- More Venezuelan oil could enter international markets.

- Increased supply may place **downward pressure on global oil prices**.
- Foreign oil companies may invest in upgrading Venezuela's oil infrastructure.

Role of U.S. Companies

- American firms may seek participation under licensed arrangements.
- The "**Chevron model**" allows foreign firms to operate with U.S. approval despite sanctions.

Implications for India

Limited Immediate Impact

- India currently does not import significant volumes of Venezuelan crude.
- Energy security is diversified across the Middle East, Russia, and other suppliers.

Future Opportunities

- If restrictions ease, Indian refiners could resume purchases of **heavy crude** suitable for complex refineries.
- **ONGC Videsh** may recover pending investments and dividends from joint ventures.
- Scope for new Indian participation in exploration and production.

Strategic Considerations

- Energy geopolitics is intertwined with **sanctions regimes and global power politics**.
- Control over oil flows affects diplomatic leverage.
- Venezuela's oil revival could reshape supply patterns in the Western Hemisphere.

Challenges

Sanctions and Legal Barriers

- Operations require approval from U.S. authorities, creating uncertainty.

Political Instability

- Governance and policy unpredictability in Venezuela discourage investment.

Infrastructure Gaps

- Significant capital is needed to modernise oil fields and refineries.

Way Forward

- Diplomatic engagement is necessary to balance energy needs with legal compliance.
- Diversified energy sourcing reduces vulnerability.
- Investments in domestic refining and renewables strengthen resilience.

Conclusion

Venezuela's oil potential remains vast but constrained by **sanctions and instability**. Any policy shift could influence

global oil prices and investment flows, offering cautious opportunities for India.

PRELIMS POINTERS IN NEWS

INDO-PACIFIC OCEANS INITIATIVE (IPOI)

Why in News?
India recently **welcomed Spain** as a participant in the **Indo-Pacific Oceans Initiative (IPOI)**. This shows growing European engagement in India's vision for a **rules-based Indo-Pacific order**.

Key Features of IPOI

- **Nature**: **Non-treaty, voluntary arrangement** — flexible and issue-based.
- **Approach**: Open to all like-minded countries; not directed against any nation.
- **Institutional Link**: Anchored around the **ASEAN-led EAS framework**, respecting **ASEAN centrality**.
- **Goal**: Enhance **maritime cooperation**, sustainability, connectivity, and security.

SEVEN PILLARS OF IPOI:

Strategic Importance for India

- Strengthens India's role as a **net security provider** in the Indian Ocean Region.
- Complements India's **SAGAR (Security and Growth for All in the Region)** vision.
- Offers an alternative, **inclusive model** compared to bloc-based security arrangements.
- Expands partnerships beyond QUAD, bringing in **Europe, ASEAN, and Indian Ocean states**.

Global Significance

- Supports **UNCLOS principles** and **freedom of navigation**.
- Promotes **blue economy and sustainable oceans governance**.

- Encourages **multilateral cooperation** amid rising maritime competition.

LIBERALISED REMITTANCES SCHEME (LRS)

Why in News?
Outward remittances under the **Liberalised Remittances Scheme (LRS)** fell to about **$1.94 billion in November 2025**, a two-year low.

About LRS

- **Introduced**: **2004** by the RBI under **FEMA, 1999**.
- **Eligibility**: Only **resident individuals** (including minors).
- **Limit**: Up to **USD 250,000 per financial year** (April–March).
- Covers both **current account** (education, travel, medical) and **capital account** (investments, property).
- Remittances above the cap require **RBI approval**.

Permitted Transactions

- **Education abroad** and related expenses
- **Medical treatment** overseas
- **Travel and tourism** (except Nepal & Bhutan)
- **Maintenance of close relatives** living abroad
- **Opening foreign bank accounts**
- **Purchase of property** overseas
- **Overseas Direct Investment (ODI)** and **portfolio investment**
- **Loans to NRI relatives** as per legal definitions

Prohibited Transactions

- Buying **lottery tickets** or banned items
- **Margin trading** on overseas exchanges
- **Forex trading abroad**
- Investment in certain **foreign currency bonds** of Indian firms in secondary markets

- Transfers to **terror-linked entities**
- Remittances to **FATF blacklisted jurisdictions**

Taxation Under LRS

- **TCS (Tax Collected at Source)** applies beyond **₹7 lakh per year**.
- Standard rate: **20%** (lower for education funded via loans).
- TCS is **adjustable against final tax liability**.
- Income from overseas investments is taxable in India under global income rules.

WORLD ECONOMIC FORUM (WEF)

Why in News?

The Union Minister recently noted that the **World Economic Forum (WEF)** at Davos functions mainly as a **dialogue platform**, not a venue for formal trade negotiations. The statement highlights the WEF's role in **idea exchange and global agenda-setting** rather than binding agreements.

Origin and Nature

- Founded in **1971** by economist **Klaus Schwab**.
- Headquartered in **Geneva, Switzerland**.
- Operates as a **public–private cooperation platform**, not an intergovernmental treaty body.
- Promotes the idea of **stakeholder capitalism**, where companies consider social and environmental responsibilities alongside profit.

Mission and Objectives

- Official mission: **"Improving the state of the world."**
- Encourages collaboration between **governments, corporations, and civil society**.
- Focuses on shaping discussions around **long-term global risks and opportunities**.

Key Activities

Annual Meeting at Davos

- Held every January in **Davos, Switzerland**.
- Brings together **heads of state, CEOs, experts, and NGOs**.
- Addresses themes like **climate action, global growth, digital governance, inequality, and security**.

Reports and Research

- Publishes influential reports such as the **Global Risks Report**, **Global Competitiveness Report**, and **Future of Jobs Report**.
- These reports guide policy debates and business strategies worldwide.

Thematic Platforms

- Works on issues such as **energy transition, AI governance, supply chains, and sustainable development**.

Funding and Membership

- Funded mainly through **membership contributions** from global corporations and institutions.
- Members include leading multinational firms, research bodies, and public institutions.

INDIA AND BANGLADESH RELATIONS

Recent **law-and-order concerns and minority safety issues** in Bangladesh have drawn attention in India. Symbolic tensions in **sports diplomacy** and political transition in Dhaka have added strain to bilateral ties.

Evolution of Relations

1. Foundation Phase (1971–1975)

- India supported Bangladesh's **Liberation War**.
- Signing of **Treaty of Friendship (1972)** and early boundary understandings.
- Strong **people-centric goodwill**.

2. Strategic Drift (1975–1996)

- Political change in Bangladesh altered foreign policy orientation.
- Rise of **water-sharing disputes** and security concerns.

3. "Golden Phase" (1996–2024)

- Improved ties under democratic governments.
- **2015 Land Boundary Agreement** resolved enclave issue.
- Maritime dispute settled peacefully.
- Expansion of **connectivity and trade**.

4. Recent Reset (2024–Present)

- Political transition in Bangladesh has led to **policy recalibration**.
- Concerns in India over **minority safety** and stability.

Key Areas of Cooperation

Economic & Trade Cooperation

- Bangladesh among India's **largest South Asian trade partners**.
- India extended **Lines of Credit** for infrastructure.

Connectivity

- Revival of **rail links** and road corridors.
- Access to **Chattogram and Mongla ports**.
- Inland waterways improving regional logistics.

Energy Cooperation

- Cross-border **electricity trade** expanding.
- **India–Bangladesh Friendship Pipeline** supplies fuel.
- Joint power projects and grid interconnections.

People-to-People Links

- Scholarships, cultural exchanges, and **medical tourism**.
- Shared **linguistic and cultural heritage**.

Security Cooperation

- Bangladesh's action against insurgent groups improved stability in India's Northeast.
- Regular coordination between border forces.

Areas of Friction

River Water Sharing

- Teesta agreement unresolved.
- Seasonal water stress affects Bangladesh.

Border Management

- Issues of **smuggling, trafficking, and migration**.
- Political sensitivity around **NRC/CAA debates**.

Trade Imbalance

- Bangladesh concerned about **market access barriers**.

Strategic Concerns

- Bangladesh's growing ties with **China** watched closely by India.

Project Delays

- Implementation challenges in infrastructure projects.

Soft Power Strains

- Recent unrest affecting **people-to-people goodwill**.
- Sports-related diplomatic signals added symbolic tension.

Way Forward

- **Diplomatic Engagement:** Maintain **continuous dialogue** while addressing sensitive concerns.
- **Water Cooperation:** Move toward **basin-level management** and data sharing.
- **Economic Integration:** Reduce **non-tariff barriers** and support joint ventures.
- **Connectivity:** Ensure **timely completion** of cross-border projects.
- **Security Collaboration:** Expand cooperation in **border management and disaster response**.
- **Energy & Green Transition:** Strengthen **renewable energy and grid connectivity**.
- **People-Centric Approach:** Simplify visas, boost education and cultural exchanges.

Conclusion

India–Bangladesh relations rest on **shared history and interdependence**. Sustained dialogue and cooperative development can ensure stability and mutual prosperity.

ECONOMY

GROWTH AND DEVELOPMENT

JOBLESS GROWTH IN INDIA: GROWTH–EMPLOYMENT MISMATCH

SOURCE: THE HINDU

Why in News?

India continues to record **high GDP growth**, yet employment creation remains uneven.

Sectoral Growth Trends

Primary Sector

- **Agriculture and allied activities** show resilience due to growth in **livestock, dairy, fisheries, and horticulture**.
- **Mining** supports infrastructure and manufacturing through supply of key minerals.

Secondary Sector

- **Manufacturing** is expanding through schemes like **PLI and Make in India**, especially in electronics, automobiles, and pharmaceuticals.
- **Construction** is a strong growth engine, supported by large public infrastructure spending, and has high employment multipliers.
- **Utilities and renewables** are growing with rising energy demand and green energy investments.

Tertiary Sector

- **Trade, tourism, logistics, and communication services** are rebounding with strong consumption.
- **Financial, real estate, and professional services** are among the fastest-growing areas.
- **IT and digital services** strengthen high-value output but mainly create **skilled jobs**.

Why Growth Is Not Generating Enough Jobs

Capital-Intensive Growth Pattern

- Modern manufacturing and infrastructure rely more on **automation and technology**, reducing labour absorption.

Services-Led Development

- High-growth services like finance and IT are **skill-intensive**, limiting opportunities for low and semi-skilled workers.

Informality and Low Job Quality

- A large workforce lacks **contracts, benefits, and wage security**, weakening inclusive growth.

Skill Mismatch

- Education expansion has not aligned with **industry requirements**, leading to graduate underemployment.

Regional Disparities

- Formal jobs are concentrated in a few industrial states, while others depend on **casual labour and self-employment**.

MSME Constraints

- Small firms face **compliance burdens and scale limitations**, restricting job creation.

Gig Economy Risks

- Short-term flexibility often leads to **long-term skill stagnation** and income insecurity.

Measures to Align Growth with Employment

Promote Labour-Intensive Manufacturing

- Focus on **textiles, food processing, leather, toys, and light engineering**.
- Link incentives with **employment generation**, not just output.

Strengthen MSMEs

- Improve access to **credit, technology, digital tools, and markets**.
- Reduce compliance burden to help firms scale up.

Infrastructure as Job Engine

- Sustain investment in **housing, transport, and urban services**, which create both direct and indirect jobs.

Agricultural Diversification

- Expand **agro-processing, logistics, and allied activities** to create rural non-farm jobs.

Expand Employment-Intensive Services

- Tourism, healthcare, education, logistics, and retail can absorb labour across skill levels.

Skill and Apprenticeship Reforms

- Strengthen **vocational training and industry-linked apprenticeships**.
- Emphasize **digital, green, and future-ready skills**.

Labour Reforms with Protection

- Simplify regulations while ensuring **social security for informal and gig workers**.

Green and Care Economy

- Jobs in **renewables, waste management, elderly care, and childcare** can provide inclusive employment.

Urban Employment Ecosystems

- Promote manufacturing-service clusters, startup hubs, and innovation centres in cities.

Conclusion

India's challenge is not lack of growth but **insufficient employment intensity** of that growth. By promoting **labour-absorbing sectors, MSMEs, skilling, and social protection**, growth can translate into **dignified jobs**.

FISCAL POLICY AND BUDGETING

STRENGTHENING FISCAL DISCIPLINE IN INDIA

SOURCE: TIIMES OF INDIA

Why in News?

India continues on a path of **fiscal consolidation**, with gradual reduction in the Union's fiscal deficit and public debt ratios.

India's Fiscal Governance Framework

Fiscal Policy

- Refers to the government's use of **taxation, expenditure, and borrowing** to influence the economy.
- Aims to manage **growth, employment, inflation, and income distribution**.

Constitutional Architecture

- **Articles 112–114**: Govern the Union budget process.
- **Articles 202–204**: Provide a similar framework for states.
- **Article 265**: No tax without legal authority.
- **Seventh Schedule**: Divides taxing powers.

Key Fiscal Institutions

- **Finance Commission (Art. 280)**: Recommends tax devolution and grants.
- **GST Council (Art. 279A)**: Joint Centre–State tax body.
- **State Finance Commissions**: Strengthen local body finances.

Legal Framework

- **FRBM Act, 2003**: Anchors fiscal discipline with deficit and debt norms.
- States have their own FRBM laws.
- Budget documents include **medium-term fiscal and macroeconomic statements**.

Key Fiscal Challenges

High Interest Burden

- Interest payments form a large share of revenue expenditure, limiting funds for **health, education, and infrastructure**.

Persistent Deficit Pressures

- Consolidation is gradual due to welfare commitments, subsidies, and capital spending needs.

Rising Public Debt

- General government debt remains significant, reducing fiscal flexibility.

State-Level Stress

- Several states face high deficits, large guarantees, and weak revenue growth.

Committed Expenditure

- Salaries, pensions, and subsidies consume a large share of revenues, crowding out development spending.

Weak Revenue Mobilisation

- India's tax-to-GDP ratio remains modest compared to many economies.
- Low tax buoyancy constrains fiscal space.

FRBM Compliance Issues

- Frequent relaxations and off-budget borrowings weaken rule credibility.

Measures to Strengthen Fiscal Management

Adopt a Credible Debt Anchor

- Focus on **medium-term debt sustainability**, not just annual deficit targets.
- Define clear Centre–State fiscal glide paths.

Improve Debt Management

- Lengthen maturity profiles, reduce refinancing risks, and deepen bond markets.

Reform State Finances

- Link borrowing flexibility to **structural reforms** such as power sector improvements and subsidy rationalisation.
- Encourage transparent reporting of liabilities.

Rationalise Expenditure

- Better targeting of subsidies using **Direct Benefit Transfers (DBT)**.
- Prioritise **capital expenditure**, which has higher growth multipliers.

Boost Revenue Mobilisation
- Broaden the tax base and improve compliance using **digital tools and analytics**.
- Simplify GST and strengthen direct tax administration.

Strengthen Fiscal Federal Coordination
- Regular Centre–State fiscal dialogues.
- Harmonised accounting and real-time fiscal data systems.

Institutional Reforms
- Enhance technical capacity of finance departments.
- Promote outcome-based budgeting and independent fiscal assessments.

Conclusion

Sustainable public finances are vital for **stable growth and development**. Stronger Centre–State coordination, better revenue mobilisation, and disciplined spending will secure India's **long-term fiscal resilience**.

CONSUMER PRICE INDEX (CPI) AND INFLATION MEASUREMENT IN INDIA

SOURCE: THE HINDU

Why in News?

India's **retail inflation** based on the Consumer Price Index recently remained well below the RBI's target band.
A **new CPI series with an updated base year** is expected soon, renewing focus on how inflation is measured.

What is the Consumer Price Index?
- CPI measures the **average change in prices** of a fixed basket of goods and services consumed by households.
- It captures **retail-level inflation**, unlike the **Wholesale Price Index (WPI)** which tracks producer prices.
- CPI-Combined (Rural + Urban) is the headline indicator for RBI's **inflation targeting framework**.

Major CPI Variants
- **CPI-Combined**: Used for national inflation assessment.
- **CPI-Industrial Workers**: Used for Dearness Allowance revision.
- **CPI-Agricultural & Rural Labourers**: Used for wage and welfare analysis.

Key Components
- **Food & Beverages** (largest share)
- Housing
- Fuel & Light
- Clothing
- Miscellaneous services (health, education, transport)

CPI vs WPI

Feature	CPI	WPI
Level measured	Retail prices	Wholesale prices
Policy use	RBI inflation targeting	Trend analysis only
Compiled by	NSO	Office of Economic Adviser
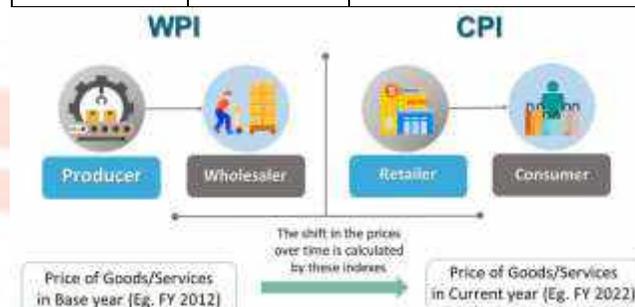
Key Issues with India's CPI

High Food Weight
- Large food share makes CPI highly sensitive to **weather shocks and supply disruptions**.
- Temporary vegetable price spikes can distort the inflation picture.

Underrepresentation of Modern Services
- Rapid growth in digital and technology-based consumption is not fully captured.
- Urban cost pressures may be understated.

Supply-Side Dominance
- Inflation often arises from **fuel prices, logistics, or imported commodities**, reducing the effectiveness of interest rate tools.

Limited Regional Detail
- National averages hide sharp price differences across states and cities.

Mismatch with Wages
- Even with moderate inflation, **slow wage growth** erodes real incomes, especially in the informal sector.

Housing Cost Underestimation
- Rental data and imputed housing costs may not reflect real market trends.

Informal Market Challenges
- Shrinkflation and quality changes are hard to capture, possibly understating actual inflation.

Measures to Improve CPI

- **Rebalance Food Weight:** Gradually adjust weights to reflect changing spending patterns.
- **Enhance Regional Coverage:** Publish state and city-level CPI for better local policy use.
- **Better Housing and Services Data:** Use broader rental and service price sources.
- **Address Supply-Side Inflation:** Combine monetary policy with **logistics reforms, buffer stocks, and trade measures**.
- **Use Modern Data Tools:** Incorporate digital price tracking and administrative datasets.
- **Reduce Seasonal Volatility:** Improve storage, processing, and market linkages in agriculture.

Conclusion

CPI remains central to **inflation management and policy decisions**. Updating its methodology and coverage will help it better reflect **real cost-of-living changes** in a transforming economy.

USER-BASED TAX ON INFRASTRUCTURE SERVICES

SOURCE: THE HINDU

Why in News?

With **direct tax expansion politically difficult** and **GST rate rationalisation limiting space**, governments are exploring **alternative revenue sources**.

User-Based Infrastructure Tax

- A **nominal cess or surcharge** on services such as **vehicles, telecom connections, rail and air travel, and freight transport**.
- Based on the **"user pays principle"**, where those benefiting from infrastructure contribute to its upkeep and expansion.
- Revenue can be earmarked for **capital investment**, not routine expenditure.

Merits of Such a Tax

Strong Revenue Potential

- High user volumes in telecom, mobility, and transport ensure **steady collections** even with low rates.
- Even a modest levy across millions of transactions can mobilise **significant annual resources** for infrastructure.

Low Burden on Individuals

- A small additional charge on a vehicle purchase, ticket, or mobile connection forms a **tiny share of total cost**.
- For most middle-income consumers, the increase is **barely perceptible**.

Price Inelastic Demand

- Essential mobility and communication services continue to be used despite minor price increases.
- Freight movement and telecom usage are **economic necessities**, ensuring stable tax flow.

Limited Impact on Inflation

- Transport and communication services carry **relatively small weights** in the consumer inflation basket.
- Hence, a small cess is unlikely to create broad-based price pressures.

Flexibility in Design

- Charges can be **graded** by vehicle type, travel class, or usage category.
- Allows balancing revenue needs with social equity.

Promotes Responsible Consumption

- Marginal cost signals may encourage **efficient use** of infrastructure without restricting access.

Key Challenges

Equity Concerns

- Even small charges can affect **low-income commuters** who depend heavily on public transport and prepaid telecom.

Administrative Complexity

- Requires seamless integration with **ticketing, billing, and vehicle registration systems** to avoid leakages.

Industry Resistance

- Transport operators, telecom firms, and manufacturers may argue that extra levies affect **profitability and demand**.

Indirect Cost Pass-Through

- Freight-related charges could raise logistics costs, which may be passed on in **product prices**.

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Way Forward

Progressive Structuring

- Higher levies on **luxury vehicles or premium travel**, lower rates for basic services.

Digital Collection Systems

- Automatic deduction through **online ticketing, FASTag, telecom billing**, and GST-linked platforms to ensure efficiency.

Dedicated Infrastructure Fund

- Ring-fence revenue for **roads, rail modernisation, ports, and digital connectivity** to build public trust.

Periodic Review

- Adjust rates based on **economic conditions and inflation** to maintain affordability.

Targeted Safeguards

- Subsidised or exempt categories for **students, rural users, or essential services**.

Conclusion

A carefully designed **user-based infrastructure levy** can create a **stable, non-disruptive revenue stream** for capital investment. With **equity safeguards, digital systems, and transparent utilisation**, it can strengthen infrastructure financing without burdening growth.

AGRICULTURE AND ALLIED

DIGITAL TRANSFORMATION OF INDIA'S DAIRY SECTOR

SOURCE: INDIAN EXPRESS

Why in News?

The **National Dairy Development Board (NDDB)** is leading large-scale **digital reforms** to modernise India's dairy value chain.

Key Digital Initiatives in the Dairy Sector

National Digital Livestock Database (Bharat Pashudhan)

- Developed under the **National Digital Livestock Mission**.
- Provides a **unique 12-digit animal ID (Pashu Aadhaar)**.
- Enables tracking of **health, breeding, vaccination, and productivity**.

Automatic Milk Collection System (AMCS)

- Digitally records **milk quantity, fat content, and quality**.
- Ensures **direct and transparent payment** to farmers.

- Sends **SMS alerts** and provides real-time cooperative data.

NDDB Dairy ERP (NDERP)

- Enterprise platform managing **finance, procurement, production, sales, HR**.
- Integrates with AMCS for **end-to-end "cow-to-consumer" digital flow**.
- Reduces losses through **mass balance monitoring**.

INAPH (Animal Productivity & Health Network)

- Captures field-level data on **breeding, feeding, and veterinary services**.
- Supports monitoring of livestock development schemes.

Semen Station Management System (SSMS)

- Tracks **bull management, semen production, quality control**, and biosecurity.
- Linked with health and breeding databases for **traceability**.

i-DIS (Internet Dairy Information System)

- National data-sharing platform for **milk procurement, processing, and distribution**.
- Helps build a **cooperative dairy database**.

GIS-Based Milk Route Optimisation

- Digital mapping tool to reduce **transport distance, fuel cost, and delays**.

Status of India's Dairy Sector

- India remains the **world's largest milk producer**.
- **Per capita milk availability** has steadily increased over the past decade.
- Leading producing states include **Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, and Maharashtra**.
- Dairy contributes a **major share of livestock output** and supports millions of small farmers.

White Revolution Legacy

- **Operation Flood** transformed India from a milk-deficit nation into a **global leader**.
- Strengthened **cooperative structures**, eliminated middlemen, and empowered rural producers, especially women.

White Revolution 2.0
- Focus on **productivity enhancement, women's participation, and nutritional security**.
- Targets expansion of cooperative procurement and adoption of **advanced breeding technologies**.

Major Challenges

Climate Stress
- Heatwaves and extreme weather reduce **milk yield**.
- Disease outbreaks such as **lumpy skin disease** disrupt production.

Rising Costs
- Sharp increase in **cattle feed prices** affects profitability.

Low Productivity
- Wide gap in yields between advanced and backward regions.

Unorganised Sector Dominance
- Large share handled outside formal systems leads to **quality and cold-chain gaps**.

Genetic and Biodiversity Concerns
- Excessive crossbreeding risks loss of **indigenous breeds**.

Environmental Impact
- Livestock contributes significantly to **methane emissions**.

Way Forward
- **Genetic Improvement:** Use of **sex-sorted semen, embryo transfer, and IVF** to expand high-yield breeds.
- **Better Nutrition:** Promote **balanced feed, TMR units, and fodder diversification**.
- **Precision Technologies:** IoT devices and AI tools for **disease detection and health monitoring**.
- **Infrastructure Expansion:** Village-level chilling units, improved testing labs, and stronger **cold chains**.
- **Digital Integration:** Universal adoption of **animal ID systems and digital milk records**.
- **Sustainability Measures:** Methane reduction through **better feed practices and biogas utilisation**.

Conclusion

India's dairy sector is evolving into a **digitally connected, farmer-centric system**. By combining **technology, genetics, and sustainability**, the sector can ensure higher incomes and long-term resilience.

RICE PRODUCTION LEADERSHIP AND SUSTAINABILITY CONCERNS

SOURCE: THE HINDU

Why in News?

India has emerged as the **largest rice producer and exporter**, supplying a major share of global trade. At the same time, rice cultivation is drawing attention for its **heavy water use and environmental stress**.

Rice in India
- Staple for a majority of the population; occupies a **large share of cultivated land**.
- Primarily a **kharif crop**, requiring high temperature, humidity, and abundant water.
- Multiple cropping cycles are possible in eastern and southern regions.
- Leading producing states include **Uttar Pradesh, West Bengal, Punjab, Telangana, and Andhra Pradesh**.

Cultivation Methods
- **Transplantation**: High yields but water and labour intensive.
- **Direct Seeded Rice (DSR)**: Reduces water use and labour needs.

1. West Bengal
2. Uttar Pradesh
3. Punjab
4. Odisha
5. Andhra Pradesh
6. Bihar
7. Chhattisgarh
8. Tamil Nadu
9. Assam
10. Telangana

Government Efforts Toward Sustainable Paddy Cultivation
- Promotion of **DSR, micro-irrigation, and diversification** under irrigation schemes.
- Development of **drought-, heat-, and salinity-tolerant varieties** through research programs.
- Push for **millet cultivation** to reduce pressure on water resources.
- Expansion of **fortified rice** distribution for nutritional security.

- Encouragement of practices like **Alternate Wetting and Drying (AWD)** to cut methane emissions.

Major Concerns with Rice-Centric Farming

Water Stress

- Rice requires **very high-water input**, causing rapid **groundwater depletion** in north-western India.
- Over-extraction creates **intergenerational inequity** by exhausting aquifers.

Environmental Impact

- Flooded fields emit **methane**, a potent greenhouse gas.
- **Crop residue burning** contributes to severe air pollution.

Health Risks

- In arsenic-prone regions, paddy irrigation can lead to **arsenic accumulation in grains**.
- Intensive pesticide use increases **toxicity in food chains**.

Economic Pressure

- Farmers incur high costs for **electricity, fertilisers, and irrigation**.
- Soil nutrient imbalance raises dependence on external inputs.

Climate Vulnerability

- Rising temperatures and erratic rainfall threaten yields, especially in **rainfed eastern regions**.

Global Food Security Link

- As a major exporter, any production shock in India can affect **global rice prices and availability**.

Steps Needed for Sustainable Agriculture

Subsidy Reforms

- Shift support from water- and input-heavy systems toward **income support and ecosystem incentives**.
- Assured procurement of **millets, pulses, and oilseeds** to encourage diversification.

Water-Saving Technologies

- Expand **SRI, DSR, drip irrigation, and precision farming**.
- Use digital advisories and soil moisture monitoring.

Groundwater Governance

- Restrict borewells in stressed zones.
- Promote **community-led water budgeting**.

Climate Resilience

- Encourage **crop rotation, agroforestry, and residue management**.
- Adopt **climate-resilient and gene-edited crop varieties**.

Farmer Income Support

- Expand crop insurance and affordable credit for sustainable practices.
- Invest in **storage, processing, and value chains**.

Conclusion

India's rice leadership reflects strong agricultural capacity but also exposes a **water–climate–health challenge**. Balancing **food security with sustainability** requires diversification, efficient irrigation, and smarter policy support.

TRADE AND EXPORTS

APPLE IMPORT DUTY: PROTECTING INDIA'S HILL HORTICULTURE

SOURCE: THE HINDU

Why in News?

Himachal Pradesh has urged the Centre to raise **import duty on apples** and impose a **seasonal import ban** to protect domestic growers.

The demand follows tariff concessions to **New Zealand apples** under the India–New Zealand trade agreement.

India–New Zealand Tariff Concession

- Import duty on certain New Zealand apples has been reduced under a **quota system**.
- A limited annual quantity can enter at **lower duty**, while imports beyond this cap attract higher tariffs.
- A **minimum import price** condition has also been specified to prevent dumping.
- The concession period overlaps with India's apple marketing cycle, intensifying farmer anxiety.

Importance of Apple Economy in India

- India produces around **28 lakh metric tonnes** of apples annually.
- **J&K** contributes nearly **two-thirds**, while **Himachal Pradesh** provides about **one-fifth** of output.
- Apples form the bulk of fruit production in these states and support **lakhs of farm households**, traders, and transport workers.
- The sector generates thousands of crores in regional income, making it crucial for **hill livelihoods**.

Farmers' Concerns

1. Price Pressure

- Imported apples arriving during India's storage-based off-season could **undercut local produce**.
- Domestic farmers rely on cold storage to sell gradually; cheaper imports may reduce returns.

2. Market Share Loss

- Premium imported varieties can capture urban markets, shrinking space for local apples.
- Farmers fear **declining bargaining power** with traders.

3. Seasonal Overlap

- New Zealand apples enter markets when Indian stored apples are sold, increasing competition at a sensitive time.

Challenges Beyond Imports

Climate Stress

- Irregular snowfall, heat waves, floods, and landslides have reduced yields and fruit quality.
- Production has fluctuated sharply in recent years due to extreme weather.

Disease Increase

- Warmer conditions have led to higher incidence of **fungal and bacterial diseases**, raising costs.

Infrastructure Gaps

- Road closures, transport delays, and limited storage facilities cause **post-harvest losses**.

Quality Concerns

- A portion of the crop often fails to meet market standards due to size and colour issues, lowering farmer income.

Farmers' Demands

- Increase **import duty** to discourage cheap inflow.
- Impose a **seasonal import restriction** during peak marketing months.
- Provide **higher subsidies**, insurance coverage, and climate-resilient support.
- Strengthen storage, grading, and marketing systems instead of relying only on trade measures.

Balancing Trade and Farmer Welfare

- Trade agreements expand market access but can expose vulnerable sectors.
- A balanced approach requires:
  - **Safeguard clauses** in FTAs
  - Investment in **productivity and quality improvement**
  - Promotion of **value-added processing**
  - Stronger **logistics and cold chains**

Way Forward

- Boost **climate-resilient horticulture** and disease management.
- Expand **controlled atmosphere storage** to stabilise prices.
- Promote branding of **Indian hill apples** for premium markets.
- Use targeted support rather than blanket protection to maintain trade credibility.

Conclusion

The apple duty debate shows the need to balance **global trade commitments** with **livelihood security** in fragile hill economies. Long-term solutions lie in **resilience, infrastructure, and quality enhancement**, not tariffs alone.

PRELIMS POINTERS IN NEWS

SMALL INDUSTRIES DEVELOPMENT BANK OF INDIA (SIDBI)

SOURCE: THE HINDU

Why in News?

The **Union Cabinet** has recently approved an **equity infusion of ₹5,000 crore** into the **Small Industries Development Bank of India (SIDBI)** to strengthen its financial capacity and support the MSME sector.

Establishment & Legal Framework

- **Founded:** *2 April 1990* under an **Act of Parliament**.
- Initially formed as a **wholly owned subsidiary** of **IDBI Bank**.
- **Delinked** from IDBI and became an independent entity on *27 March 2000*.
- **Headquarters:** *Lucknow*, Uttar Pradesh.
- Operates under regulatory oversight from the **Government of India**.

Mandate & Objectives

SIDBI's core mandate revolves around the **triple agenda**:

1. **Promotion** of MSMEs across sectors.
2. **Financing** enterprises directly and through intermediaries.
3. **Development** initiatives and **coordination** among institutions involved in MSME support.

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Key Functions
Financial Support

- **Direct Lending:** Provides term loans, working capital support, and tailored credit to MSMEs.
- **Refinancing:** Offers refinance facilities to **Scheduled Commercial Banks**, **NBFCs**, and other financial institutions for onward lending to MSMEs.

Developmental & Promotional Roles

- **Entrepreneurship Promotion:** Supports capacity building, training, and incubation for new and emerging enterprises.
- **Technology & Innovation Support:** Facilitates technology upgradation and adoption among MSMEs.
- **Venture Capital & Equity Support:** Provides risk capital to promising start-ups and scaling enterprises.

Specialised Interventions

- **Risk Capital:** Financing in high-growth potential sectors requiring equity and quasi-equity.
- **Sustainable Finance:** Support for green and environmentally sustainable MSME initiatives.
- **Receivables Financing:** Addresses liquidity challenges through invoice discounting and factoring.

Funds Administered by SIDBI

- **Small Industries Development Fund (SIDF):** Offers long-term funding support for MSME growth.
- **National Equity Fund (NEF):** Provides equity backing for entrepreneurial expansion and innovation.

CSIR INTEGRATED SKILL INITIATIVE (CSIR-ISI)

SOURCE: THE HINDU

Why in News?
The **CSIR Integrated Skill Initiative** has reportedly trained over **1.9 lakh individuals** through more than **5,200 skill-oriented programmes** across India.

Objectives

- Bridge the gap between **laboratory research** and **industrial needs**.
- Promote **technology-based skill development**.
- Enhance **employability, entrepreneurship, and innovation capacity**.
- Use CSIR's nationwide network of **laboratories and research centres** for training delivery.

Target Beneficiaries
The initiative follows an **inclusive approach**, covering:

- **Students and young researchers**
- **Technical staff and working professionals**
- **ITI diploma holders and school dropouts**
- **Farmers and rural youth**
- Individuals seeking **upskilling or reskilling** in modern technologies.

Key Features

- Offers **short-term and long-term courses**.
- Includes **hands-on lab training, internships, certification programmes**, and industrial exposure.
- Focus on **emerging technology domains** such as biotechnology, advanced materials, environmental technologies, and digital tools.
- Aligns training content with **real-world industry and societal needs**.

Sectoral Coverage

- Covers multiple sectors aligned with the **National Skill Development Mission (NSDM)**.
- Training spans a wide range of **technology-intensive and service sectors**.

EXPORT PREPAREDNESS INDEX 2024

SOURCE: THE HINDU

Why in News?
NITI Aayog has released the **Export Preparedness Index (EPI) 2024**, assessing how ready Indian States and UTs are to boost exports.

Background

- First edition released in **2020**.
- **EPI 2024** marks the **fourth edition**.
- Encourages **competitive and cooperative federalism** in trade development.

Framework of EPI 2024

The index is built on **four key pillars**, divided into sub-pillars and indicators:

1. **Export Infrastructure (20%)**
   - Quality of transport, logistics, and trade infrastructure.
   - Access to ports, dry ports, and warehousing.
2. **Business Ecosystem (40%)**
   - Ease of doing business.
   - Industrial base, MSME support, and innovation capacity.
3. **Policy & Governance (20%)**
   - State-level export policies.
   - Institutional support, trade promotion bodies, and digital facilitation.
4. **Export Performance (20%)**
   - Growth and diversification of exports.
   - Share in national exports.

Classification of States & UTs

Regions are grouped into:

- **Large States**
- **Small States**
- **North Eastern States**
- **Union Territories**

They are further categorised as:

- **Leaders** – Strong export ecosystem
- **Challengers** – Moderate readiness
- **Aspirers** – Early-stage development

Leading Performers (EPI 2024)

- **Large States:** Maharashtra, Tamil Nadu, Gujarat, Uttar Pradesh, Andhra Pradesh
- **Small/NE States & UTs:** Uttarakhand, Jammu & Kashmir, Nagaland, Dadra & Nagar Haveli and Daman & Diu, Goa

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OPEN NETWORK FOR DIGITAL COMMERCE (ONDC)

SOURCE: THE HINDU

Why in News?

The **Archaeological Survey of India (ASI)** has enabled **online ticket booking for over 170 monuments and museums** through the **ONDC network**.

About Open Network for Digital Commerce

- The **Open Network for Digital Commerce (ONDC)** is a Government of India initiative aimed at building an **open, interoperable digital commerce ecosystem**.
- It seeks to shift e-commerce from a **closed platform model** to a **network-based model**.

Institutional Background

- Spearheaded by the **Department for Promotion of Industry and Internal Trade (DPIIT)** under the **Ministry of Commerce & Industry**.
- Launched in **2022**.
- Operates using **open standards and protocols** rather than a single proprietary platform.

Core Idea

- Enables buyers and sellers to transact **across different applications**.
- Breaks the dominance of a few large platforms.
- Encourages **interoperability and decentralisation**.

Objectives

- **Democratise digital commerce**.
- Increase **inclusivity** for small retailers, MSMEs, and artisans.
- Reduce **entry barriers and transaction costs**.
- Expand access to **regional and local markets**.
- Enhance **consumer choice**.

Operational Structure

- **Buyer-side apps:** For consumers to search and order.
- **Seller-side apps:** For merchant onboarding and listing.
- **Logistics services:** For delivery and fulfilment.
- Common protocols standardise **cataloguing, inventory, order management**, and payments.

Sectors Covered

- Retail goods and groceries
- Food delivery
- Mobility services
- Travel and hospitality
- Services such as ticketing (including heritage monuments)

Benefits

- Empowers **small businesses** to reach nationwide customers.
- Helps build **digital transaction history** for credit access.
- Improves **logistics efficiency**.
- Encourages **competition and innovation**.

Significance

- Supports India's **Digital Public Infrastructure (DPI)** vision.
- Promotes **fair and open digital markets**.
- Bridges the **digital divide**.

INDIA'S E-COMMERCE SECTOR

India's **e-commerce market** continues rapid expansion, driven by **digital payments, logistics upgrades, and MSME participation**.

Key Drivers of E-Commerce Growth

1. Digital Payments & UPI Backbone

- **UPI** enables **instant, low-cost transactions**, reducing cash dependence.
- Facilitates **micro-payments**, critical for small-ticket purchases.
- Speeds up **seller cash cycles** and builds transaction history for credit.

2. Internet & Smartphone Penetration

- Affordable devices and data have expanded the **digital consumer base**.
- Growth in **vernacular content, video commerce, and mobile-first UX**.
- Network upgrades support **rich shopping experiences**.

3. Logistics & Last-Mile Innovation

- Expansion of **warehouses, dark stores, and route optimisation**.
- Growth of **quick commerce** improving delivery speed.
- Cold-chain investments allow online sale of **perishables and medicines**.

4. MSME Integration & Open Networks

- Platforms reduce **market access barriers** for small sellers.
- **ONDC** model promotes **interoperability** and seller diversity.
- Supports **local product discovery** beyond metro markets.

5. Cross-Border E-Commerce

- Enables MSMEs to access **global demand**.
- Platforms provide **logistics and compliance support**.
- Boosts **value-added exports** (textiles, handicrafts, foods).

6. AI & Data Analytics

- AI improves **product discovery, pricing, demand forecasting**.
- Automation helps small sellers in **cataloguing and marketing**.
- Enhances **conversion rates and inventory efficiency**.

7. Evolving Business Models

- Mix of **marketplace, inventory-led, and quick commerce**.
- Different models balance **capital intensity, margins, and speed**.

Regulatory Framework

Consumer Protection (E-Commerce) Rules

- Mandate **transparency in pricing and origin**.
- Require **grievance redressal officers**.
- Prohibit **misleading ads and fake reviews**.

FDI & FEMA Norms

- **100% FDI allowed in marketplace model** only.
- Restrictions on **inventory ownership and related-party sellers**.

Data Protection

- **DPDP Act** enforces **consent-based data use**.
- Provides **right to deletion** and penalties for misuse.

Competition Oversight

- **CCI** monitors **self-preferencing, exclusive deals**, and unfair practices.

Government Initiatives Supporting E-Commerce

- **ONDC** – Open network reducing platform dominance.
- **GeM** – Digital public procurement expanding MSME participation.
- **E-commerce Export Hubs** under Foreign Trade Policy.
- **India Post integration** improving rural logistics.
- **Dark Pattern Guidelines** protecting consumers.
- **Credit on UPI** enabling embedded finance.
- **Bhashini** for multilingual digital commerce.

- **TEAM Scheme** promoting MSME digital onboarding.

Indian E-commerce Market (US$ billion)

Source: News articles, F- Forecasted

Key Issues & Challenges

1. Competition Concerns

- Allegations of **preferred seller bias** and platform self-preferencing.
- Risk of **market concentration**.

2. Gig Worker Safety

- Quick commerce pressures leading to **road safety and labour concerns**.
- Need for **social security and worker protections**.

3. Dark Patterns & Consumer Manipulation

- Use of **deceptive UX designs** affecting consumer choice.

4. ONDC Adoption Challenges

- Early-stage issues in **user experience and dispute resolution**.

5. Sustainability Concerns

- High **return rates** increasing carbon footprint.
- Excessive **plastic packaging**.

6. Fake Reviews & AI Misuse

- **AI-generated reviews** eroding trust.

Measures Needed

- **Strengthen ONDC Ecosystem:** Integrate **AI-based tools** and real-time grievance systems.
- **Ex-Ante Competition Regulation:** Conduct **platform neutrality audits**.
- **Green Logistics:** Incentivise **EV fleets and eco-friendly packaging**.
- **Rural Digital Trade Hubs:** Build **district-level logistics centres**.
- **Data Trust & Privacy:** Enforce **privacy-by-design** and ban dark patterns.
- **Gig Worker Welfare:** Portable **social security and insurance coverage**.

Conclusion

India's **e-commerce sector** is central to digital growth, MSME empowerment, and innovation. Balanced regulation, sustainability, and trust-building are essential for long-term inclusive expansion.

HISTORY

PRELIMS POINTERS IN NEWS

GORAKHNATH TEMPLE

SOURCE: INDIAN EXPRESS

Why in News?
A large number of devotees assembled at the temple ahead of **Makar Sankranti**, offering **khichdi** as part of a long-standing ritual dedicated to **Guru Gorakhnath**.

Historical & Religious Background

- Linked to the **Nath Sampradaya**, founded by **Matsyendranath**.
- Guru Gorakhnath is regarded as a **spiritual reformer and yogic master**.
- The temple serves as the **main seat (peeth)** of the Nath sect.
- Nath philosophy blends **Shaivism, yoga practices, and ascetic traditions**.

Architectural Features

- Reflects a mix of **traditional North Indian temple architecture** with later additions.
- Central sanctum houses the **idol of Gorakhnath** along with a **Shiva Linga**.
- Surrounded by **stone carvings, pillars, and marble structures** symbolising spiritual themes.
- A **tall conical dome** makes the temple visible from afar.
- The complex includes a sacred **Samadhi shrine** associated with Gorakhnath.

Rituals & Festivals

- **Makar Sankranti Khichdi Mela** is the most significant event.
- Devotees offer **khichdi (rice-lentil preparation)** as a sacred offering.
- Rituals emphasise **simplicity, devotion, and yogic discipline**.
- The festival attracts pilgrims from multiple states.

Cultural Significance

- Centre for **yoga traditions and spiritual teachings**.
- Acts as a hub for **religious gatherings, fairs, and community activities**.
- Reflects the **continuity of medieval yogic traditions** in modern India.

BHADRAKALI INSCRIPTION

SOURCE: THE HINDU

Why in News?
The **Bhadrakali inscription** has gained attention for providing historical evidence about the **Somnath Temple's development** and the patronage of the **Solanki dynasty**. It is an important medieval epigraphic record preserved in **Gujarat**.

Location & Date

- Found on the wall of the **Bhadrakali Temple** at **Prabhas Patan**, near Somnath.
- Dated to **1169 CE**.
- Currently protected by the **State Department of Archaeology, Gujarat**.

Nature of the Inscription

- A **eulogistic (prasasti) inscription**.
- Dedicated to **Bhavabrihaspati**, a **Param Pashupata Acharya** and spiritual guide to **King Kumarapala** of the Solanki (Chaulukya) dynasty.
- Reflects the close association between **religion and royal patronage**.

- Mentions the **mythological history** of Somnath Temple across four yugas:
  - **Satya Yuga:** Built in gold by **Soma (Moon God)**.
  - **Treta Yuga:** Rebuilt in silver by **Ravana**.
  - **Dvapara Yuga:** Constructed in wood by **Shri Krishna**.
  - **Kali Yuga:** A grand stone temple attributed to **Bhimdev Solanki**.
- Highlights the **devotion of Solanki rulers** towards Shaivism.
- Indicates the role of scholars and spiritual leaders in temple patronage.

Cultural & Historical Significance
- Provides evidence of **temple reconstruction traditions**.
- Demonstrates the importance of **Somnath as a major pilgrimage centre**.
- Reflects medieval **epigraphic practices** and political-religious ties.
- Aids in reconstructing **regional history of Gujarat**.
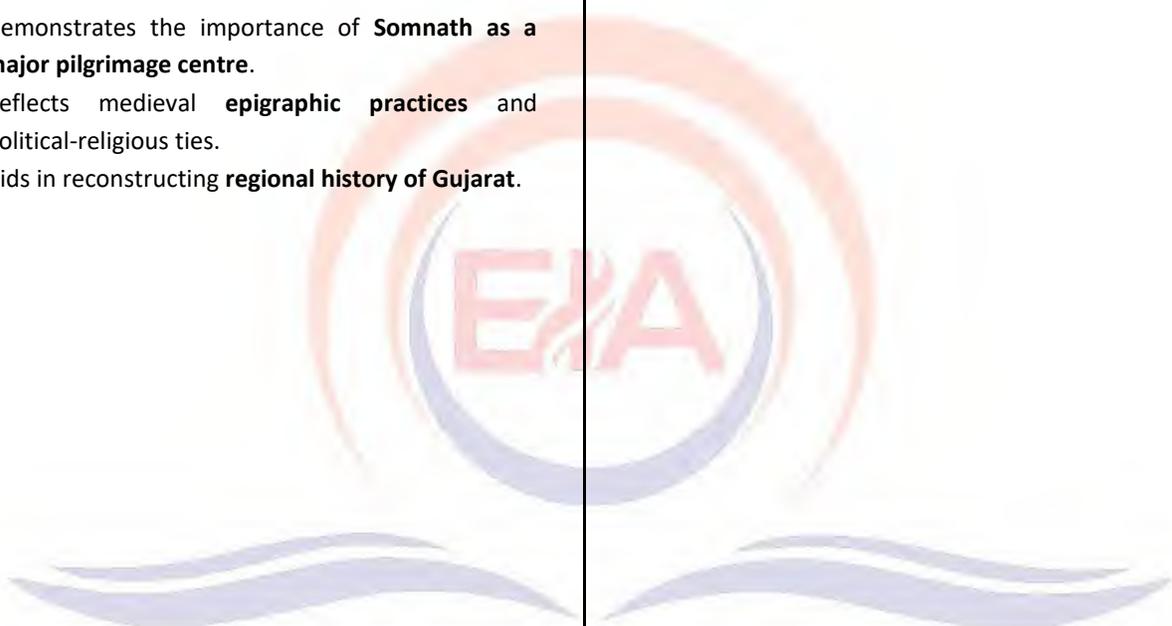
GEOGRAPHY

PRELIMS POINTERS IN NEWS

MOUNT ASO

SOURCE: THE HINDU

Why in News?
A helicopter recently went missing near **Mount Aso** in Japan, prompting a large-scale search due to the volcano's **high activity levels**. The incident has drawn attention to the **geological hazards** associated with active volcanic regions.

Location and Physical Features
- Situated in **Kumamoto Prefecture**, Kyushu, southern Japan.
- Highest peak, **Takadake**, rises to about **1,592 metres**.
- Part of the **Aso-Kuju National Park**, a major natural heritage area.
- Lies along the **Pacific Ring of Fire**, where tectonic plate movements cause intense volcanic and seismic activity.

Caldera and Crater System
- Mount Aso has one of the **largest volcanic calderas in the world**.
- The caldera stretches roughly **25 km north–south** and **18 km east–west**.
- Formed by a series of massive eruptions thousands of years ago.
- Inside the caldera lies **Nakadake**, the most active crater, which frequently emits **ash, gas, and steam**.

Volcanic Activity
- Classified as a **highly active stratovolcano**.
- Has experienced **regular eruptions**, including notable events in **2016 and 2021**.
- Activity includes **ash plumes, pyroclastic material, and toxic gas emissions**, posing aviation and local safety risks.
- Japan's Meteorological Agency continuously monitors it.

KAMCHATKA PENINSULA

SOURCE: INDIAN EXPRESS

Why in News?
Russia's **Kamchatka Peninsula** has recently experienced **record snowfall and intense winter storms**, disrupting transport and daily life.

Location and Geography
- Situated between the **Sea of Okhotsk (west)** and the **Pacific Ocean & Bering Sea (east)**.
- Forms part of **Kamchatka Krai**, one of Russia's largest but sparsely populated administrative regions.
- The peninsula stretches over **1,200 km**, making it one of the **largest peninsulas globally**.
- The **Kuril Island chain** extends southward from Kamchatka toward Japan's **Hokkaido**.

Volcanic and Geological Significance
- Lies directly on the **Pacific Ring of Fire**, a zone of frequent tectonic activity.
- Hosts **over 150 volcanoes**, with nearly **30 considered active**.
- The **"Volcanoes of Kamchatka"** is a **UNESCO World Heritage Site**, recognised for its exceptional geological value.

- Frequent **earthquakes, hot springs, geysers, and fumaroles** show ongoing geothermal activity.

Highest Peak

- **Klyuchevskaya Sopka** is the highest volcano in Eurasia outside the Caucasus, rising to about **4,750 metres**.
- It is one of the **most active stratovolcanoes** in the world.

Climate Characteristics

- Experiences a **subarctic maritime climate**.
- **Winters**: Extremely cold, long, and snow-heavy due to moisture from surrounding seas.
- **Summers**: Cool and relatively wet.
- Frequent storms make it prone to **avalanches and blizzards**.

MUNA ISLAND

SOURCE: TIMES OF INDIA

Why in News?

A hand-shaped rock painting on **Muna Island, Indonesia** has been dated to **at least 67,800 years old**, making it one of the **oldest known examples of human rock art** in the world.
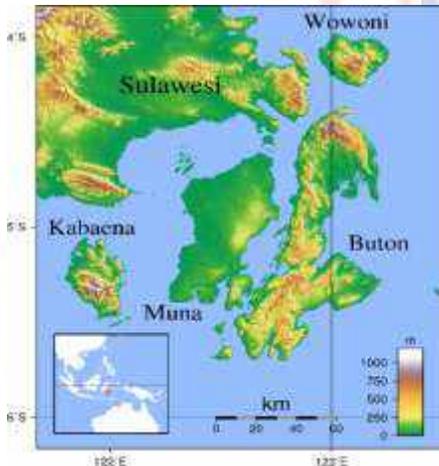
Geography & Location

- Located in the **Southeast Sulawesi** region of **Indonesia**.
- Covers around **1,700–3,200 sq km** with **hilly terrain** rising up to about **445 metres** above sea level.
- The **northern and northeastern areas** are covered with **teak forests**.
- The main urban centre and port is **Raha**, situated on the northeastern coast.

Population & Culture

- Inhabited primarily by the **Muna people**, alongside Bugis and other ethnic groups.

- Known for **distinctive traditional dances, music, and handicrafts**.
- The cultural life of the island reflects a blend of **Austronesian traditions** and local practices.

Economy

- Predominantly **agriculture and fishing-based economy**.
- Local crafts and cottage industries contribute to livelihoods.
- Marine and coastal resources play an important role in community sustenance.

Prehistoric Rock Art Discovery

- A **hand stencil** painted in red ochre inside a limestone cave on the island has been dated to **at least 67,800 years old**.
- This makes it one of the **earliest known forms of figurative expression** by humans.
- The artwork was created by **blowing pigment around a hand** pressed against the cave surface.
- The dating was established using advanced mineral analysis techniques.
- The find challenges earlier ideas about the origins of symbolic art and suggests **early human cultural complexity in Southeast Asia**.

Other Attractions

- **Liangkobori (Kobori) Cave**, known for prehistoric paintings.
- **Napabale Lake**, a scenic saltwater lake connected to the sea via a natural tunnel.

SELA LAKE

SOURCE: THE HINDU

Why in News?

Two tourists recently died after the **frozen surface of Sela Lake** in Arunachal Pradesh's Tawang district cracked, highlighting risks linked to **high-altitude glacial lakes**. The incident has raised concerns over **tourist safety, fragile Himalayan ecology, and climate sensitivity** of such regions.

Location and Physical Features

- **Sela Lake**, also called **Paradise Lake**, is a **high-altitude glacial lake** in **Tawang district, Arunachal Pradesh**.
- Situated near **Sela Pass**, at about **4,170 m (13,700 ft)** above sea level.
- Sela Pass connects **Tawang** with the rest of Arunachal Pradesh and is strategically important for **border connectivity**.
- The lake is surrounded by **snow-covered Eastern Himalayan peaks**, creating a typical **alpine landscape**.

Climatic and Ecological Characteristics

- Experiences **sub-zero temperatures** for most of winter, causing the lake surface to **freeze seasonally**.
- The region falls under **cold desert–alpine conditions** with **thin air, low oxygen**, and limited vegetation.
- Supports fragile **high-altitude biodiversity**, including alpine grasses, lichens, and migratory birds in warmer months.
- Glacial lakes like Sela are sensitive indicators of **climate change**, as warming alters ice cover and water levels.

Cultural and Religious Importance

- Considered a **sacred site** by local **Monpa Buddhist communities**.
- Part of the network of **sacred lakes in the Tawang region**, linked with local spiritual traditions.
- Often visited by monks and pilgrims, apart from tourists.

Strategic and Tourism Relevance

- Located on the route to **Tawang Monastery** and close to the **India–China border**, giving it **defence significance**.
- Increasingly popular for **snow tourism, photography, and road travel** along the Tawang circuit.
- Winter tourism has grown, but frozen surfaces can be **deceptively unsafe**.

Risks and Concerns

- **Ice instability**: Frozen lakes may appear solid but weaken due to temperature variation.
- **High-altitude hazards**: Hypoxia, frostbite, and sudden weather changes.
- **Ecological fragility**: Unregulated tourism may cause **waste accumulation and habitat disturbance**.

- Climate change may increase **glacial melt variability**, affecting lake stability.

Way Forward

- Install **warning systems, fencing, and signage** around vulnerable lake zones.
- Regulate winter tourism with **local administration and ITBP coordination**.
- Promote **eco-sensitive tourism** and strict waste management.

ENVIRONMENT

BIODIVERSITY AND CONSERVATION

GRASSLANDS AND CLIMATE GOVERNANCE

SOURCE: HINDUSTHAN TIMES

Why in News?

Global climate discussions continue to emphasise **forests**, while **grasslands** receive limited attention in mitigation and conservation agendas. The UN's declaration of **2026 as the International Year of Rangelands and Pastoralists (IYRP)** has renewed focus on their ecological and livelihood value.

About Grasslands

- Open landscapes with **low tree cover**, including savannas, rangelands, and pasture commons.
- Among the **largest terrestrial ecosystems**, covering a substantial share of Earth's land surface.
- Store large amounts of **soil carbon**, particularly in tropical and semi-arid zones.
- Sustain millions of **pastoralists and agro-pastoralists** who depend on livestock rearing.
- Ecologically maintained by **natural disturbances** such as grazing and periodic fires.

Grasslands in India

- Found in western India, central plateaus, the Deccan region, Terai belt, and Himalayan alpine zones.
- Support iconic species like **Great Indian Bustard, blackbuck, and wolf**.
- Only a **small fraction** falls within formal protected areas.
- Frequently mislabelled as "wastelands," leading to diversion.

Ecological and Socio-Economic Importance

Climate Regulation

- Significant **carbon sequestration** occurs in soils rather than above-ground biomass.
- Provide resilience against drought and climatic variability.

Biodiversity Support

- Habitat for specialised flora and fauna adapted to open landscapes.
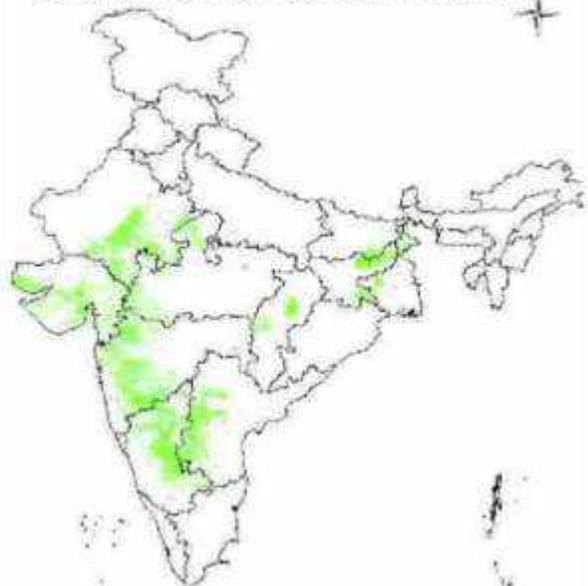- Support pollinators and migratory birds.

Livelihoods

- Provide grazing, fodder, fuelwood, and non-timber products.
- Backbone of traditional **pastoral economies**.

Hydrological Functions

- Enhance **infiltration**, recharge groundwater, and prevent erosion.

Grassland distribution in India

Gaps in Conservation and Policy

Misclassification

- Often recorded as degraded forests or unused land, encouraging **plantations and infrastructure projects**.

Forest-Centric Climate Policies

- Afforestation drives and carbon schemes prioritise tree cover, ignoring grassland ecology.

Fragmented Governance

- Multiple ministries handle land, forests, and rural development with little coordination.

Legal Vacuum

- Unlike forests or wetlands, grasslands lack a dedicated legal framework for protection.

Neglect of Traditional Management

- Controlled grazing and fire practices are discouraged despite ecological benefits.

Weak Data Systems

- Absence of a **comprehensive grassland inventory** limits planning and monitoring.

Marginalisation of Pastoralists

- Commons are shrinking, and mobility routes are disrupted by land-use changes.

Measures for Strengthening Grassland Governance

Recognise Grasslands as Distinct Ecosystems

- Official land-use classification should differentiate grasslands from forests and wastelands.

Integrate into Climate Commitments

- Include **soil carbon and rangeland restoration** in national climate strategies rather than relying only on tree plantations.

Legal Protection

- Develop a **national policy for grassland and rangeland conservation**.
- Extend safeguards through wildlife and environmental laws.

Ecosystem-Based Management

- Adopt landscape approaches linking biodiversity, livelihoods, and climate resilience.

Empower Pastoral Communities

- Secure grazing rights and recognise community stewardship models.

Science-Based Restoration

- Focus on native grasses and control of invasive species rather than monoculture plantations.

Improve Data and Monitoring

- Establish a **national grassland atlas** and standard indicators for ecosystem services.

Align Development with Conservation

- Mandate environmental assessments and local consent before diversion of grasslands.

Conclusion

Grasslands are **critical yet neglected ecosystems** that sustain biodiversity, climate stability, and pastoral livelihoods. Mainstreaming them in policies, laws, and climate action—especially during **IYRP 2026**—is vital for balanced and inclusive ecosystem governance.

REGULATING RELIGIOUS STRUCTURES INSIDE WILDLIFE SANCTUARIES

**SOURCE: THE HINDU**

Why in News?

An apex wildlife advisory authority has prepared **draft norms** to regulate diversion of forest land inside **wildlife sanctuaries** for religious constructions.

Why Were Guidelines Needed?

- A recent proposal in a sanctuary in western India for a religious facility triggered debate over **legal status and ecological impact**.
- Initial approvals were questioned due to **absence of recognised forest rights** and risk of setting a precedent.
- States follow **different approaches**, leading to inconsistency.
- Many existing shrines lack formal land records, creating **governance ambiguity**.

Key Features of the Draft Guidelines

- **Post-1980 constructions** on forest land are generally to be treated as **encroachments**.
- **Regularisation** may be considered only in **rare and justified cases**, backed by documented reasons from the State government.
- **Expansion of religious structures** within sanctuaries is largely **prohibited**.
- **Limited** construction may be allowed only for **essential safety, ecological management, or basic public utilities**.
- Every proposal requires **case-by-case ecological assessment**.
- Final approval remains with the **Central Government**, based on expert review.
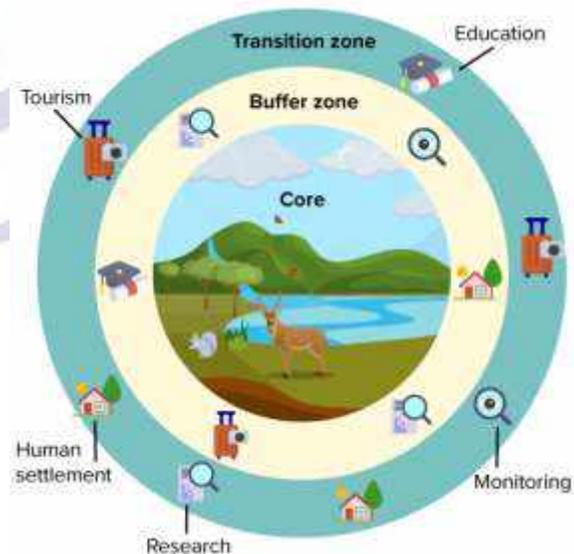
Balancing Faith and Ecology

- India has a tradition of **sacred groves** and forest-based worship.
- However, large gatherings, roads, and construction can lead to:
  - **Habitat fragmentation**
  - **Increased human–wildlife conflict**
  - Waste generation and noise disturbance

- Constitutional freedom of religion does not permit activities that **damage ecologically sensitive zones**.
- The guidelines recognise **historical presence** but discourage **new encroachments**.

Legal and Institutional Framework

Wildlife (Protection) Act, 1972

- Governs declaration and management of **sanctuaries and national parks**.
- Restricts activities that can **alter habitat** or disturb wildlife.

Forest (Conservation) Act, 1980

- Any diversion of forest land for **non-forest purposes** after 1980 needs **Central approval**.
- Reinforces the principle that **conservation takes priority**.

National Board for Wildlife (NBWL)

- The **Standing Committee of NBWL (SCNBWL)** reviews proposals affecting wildlife habitats.
- Advises the Centre on whether projects inside PAs are compatible with **conservation objectives**.

Implications for Conservation Governance

Positive Outcomes

- Prevents gradual **shrinking of protected areas** through piecemeal construction.
- Provides **uniform criteria** across States.
- Strengthens the legal position of forest and wildlife authorities.

Risks

- Political or local pressure may lead to **lenient interpretation**.
- Weak monitoring can allow **incremental expansion** over time.

Way Forward

- Develop a **national inventory** of existing religious sites within PAs.
- Ensure **transparent decision-making** with ecological data in the public domain.
- Promote **eco-sensitive pilgrimage management** — regulated visitor numbers, waste control, and seasonal access.
- Strengthen coordination between **forest departments, local communities, and religious bodies**.
- Encourage awareness that **conservation is a shared cultural duty**.

Conclusion

The draft norms aim to protect **wildlife habitats** while addressing legacy religious sites in forests.

Effective implementation can ensure that **faith practices do not erode protected areas**, preserving biodiversity for future generations.

GREAT INDIAN BUSTARD (GIB) CONSERVATION AND SUPREME COURT DIRECTIONS
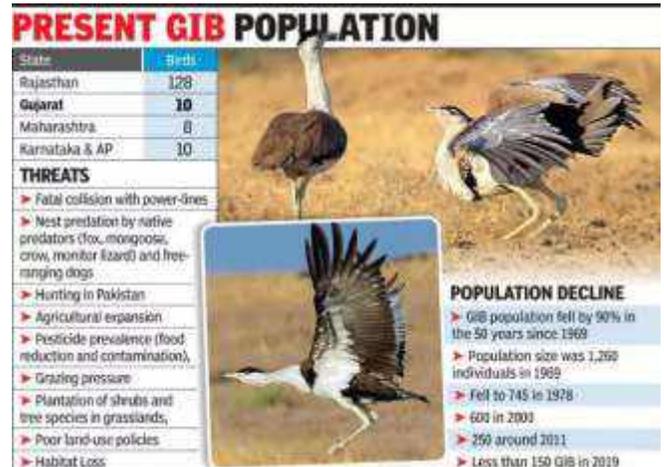
SOURCE: THE HINDU

Why in News?

The **Supreme Court of India** has issued major directions to protect the **Great Indian Bustard (GIB)** by regulating **overhead power lines** in its habitat. The ruling aims to reduce bird deaths while balancing **renewable energy expansion** and wildlife conservation.

About the Great Indian Bustard

- Scientific name: **Ardeotis nigriceps**
- Habitat: **Arid grasslands** of Rajasthan and Gujarat
- Status: **Critically Endangered (IUCN)**
- Population: Estimated to be **fewer than 200 individuals** in the wild
- Biological vulnerability:
    - Heavy body and limited frontal vision
    - Low reproductive rate
    - Prefers open landscapes where power lines are difficult to detect

What the Supreme Court Examined

- Petition raised concern over **bird collisions with transmission lines** linked to wind and solar projects.
- Earlier directions (2021) included a **blanket restriction on new overhead lines** in GIB habitats and mandatory mitigation.
- Later, practical difficulties were highlighted by power and renewable energy authorities, leading to reconsideration.

PRESENT GIB POPULATION

State	Birds
Rajasthan	128
Gujarat	10
Maharashtra	8
Karnataka & AP	10

THREATS
- Fatal collision with power-lines
- Nest predation by native predators (fox, mongoose, crow, monitor lizard) and free-ranging dogs
- Hunting in Pakistan
- Agricultural expansion
- Pesticide prevalence (food reduction and contamination),
- Grazing pressure
- Plantation of shrubs and tree species in grasslands,
- Poor land-use policies
- Habitat Loss

POPULATION DECLINE
- GIB population fell by 90% in the 50 years since 1969
- Population size was 1,260 individuals in 1969
- Fell to 745 in 1978
- 600 in 2001
- 250 around 2011
- Less than 150 GIB in 2019

Balancing Conservation and Clean Energy

The Court recognised:

- India's need to expand **renewable energy** for climate goals.
- The urgent need to prevent extinction of the **GIB**.
- That **undergrounding alone** cannot fully solve the issue.

An **expert committee** of wildlife scientists and power sector specialists was formed to suggest balanced measures.

Key Measures Ordered by the Court

Revised Priority Conservation Areas

- **Rajasthan** priority zones expanded to over **14,000 sq km**.
- **Gujarat** priority areas increased to around **740 sq km**.
- These cover **core breeding and foraging habitats**.

Powerline Management

- No new overhead lines in priority zones except through **designated corridors**.
- **Low-voltage lines** may be exempt under specific conditions.
- Creation of **dedicated powerline corridors** to concentrate transmission routes and reduce collision risks.

Undergrounding of Lines

- Immediate undergrounding of significant stretches of **medium-voltage lines** in Rajasthan and Gujarat.
- Remaining critical lines to be buried or rerouted within **fixed timelines**.

Wind and Solar Restrictions

- No new **wind turbines** inside priority areas.
- No large **solar parks** or expansion of existing ones in these zones.

Bird Diverters and Technology

- The Court paused blanket use of **bird flight diverters**.
- Directed further **scientific assessment** of their effectiveness.
- Emphasised **evidence-based conservation** rather than ad-hoc solutions.

Habitat and Species Recovery Measures

Grassland Ecosystem Restoration

- Restoration and protection of **native grasslands**, the GIB's primary habitat.

In-situ Management

- Secure breeding areas through **enclosures**.
- **Predator control**, especially stray dogs.
- Ensuring food and water availability.

- Community participation to reduce disturbances.

Breeding Support

- Use of **assisted breeding strategies**, including egg management and chick rearing.
- GPS tracking to monitor movement and survival.

Significance of the Judgment

- Establishes a **science-based framework** for infrastructure planning in sensitive wildlife zones.
- Moves away from blanket bans to **targeted ecological safeguards**.
- Recognises **grasslands** as vital ecosystems.
- Sets precedent for balancing **development and biodiversity**.

Challenges Ahead

- High cost and technical challenges of undergrounding power lines.
- Need for coordination between wildlife authorities and energy developers.
- Ensuring strict implementation without political or commercial dilution.

Conclusion

The Supreme Court's decision marks a major step in protecting the **Great Indian Bustard** while accommodating clean energy goals. Success now depends on **effective implementation**, scientific monitoring, and long-term grassland conservation.

CLIMATE CHANGE AND POLLUTION

GROUNDWATER MANAGEMENT IN INDIA

SOURCE: THE HINDU

Why in News?

India's **groundwater resources**, crucial for farming and drinking water, are under rising stress due to **over-extraction and contamination**.

About Groundwater

- Groundwater is water stored in **underground aquifers**, constituting the majority of accessible freshwater.
- In India, it supports around **two-thirds of irrigation**, **most rural drinking water**, and a substantial share of urban supply.

- India is among the **largest groundwater users globally**, reflecting heavy reliance on wells and tube wells.
- Governance is primarily a **State subject**, while the Centre provides technical guidance and funding support.

Drivers of Groundwater Depletion
Policy and Economic Distortions
- Free or subsidised electricity encourages **excessive pumping**.
- Procurement policies favour **water-intensive crops** such as paddy and sugarcane in semi-arid regions.

Urbanisation and Population Growth
- Expansion of cities reduces natural recharge zones through **concretisation**.
- Rising domestic and industrial demand intensifies extraction.

Climate Change
- Erratic monsoons and rising temperatures reduce **natural recharge** and raise irrigation demand.
- Increased drought frequency deepens reliance on aquifers.

Water Quality Degradation
- Overuse of fertilisers and industrial discharge contaminates aquifers with **nitrates, fluoride, heavy metals**, and salinity.
- Coastal regions face **seawater intrusion** due to over-pumping.

Legal and Institutional Gaps
- Groundwater historically linked to land ownership, limiting **collective regulation**.
- Multiple agencies operate with **weak coordination**, reducing enforcement effectiveness.

Government Initiatives
Legal and Regulatory Measures
- **Model Groundwater Bill** encourages states to regulate extraction and promote community participation.

Conservation Campaigns
- **Jal Shakti Abhiyan: Catch the Rain** promotes rainwater harvesting and revival of water bodies.
- **Mission Amrit Sarovar** focuses on creating and rejuvenating ponds for recharge.

Scientific Mapping and Planning
- **National Aquifer Mapping Programme (NAQUIM)** identifies aquifer characteristics and guides management plans.

Community-Based Schemes
- **Atal Bhujal Yojana** supports participatory groundwater management in water-stressed districts.

Artificial Recharge Efforts
- Master plans encourage construction of recharge structures such as check dams and percolation tanks.

Strategies for Sustainable Groundwater Management
Water-Efficient Agriculture
- Promote **micro-irrigation, crop diversification**, and less water-intensive crops.
- Integrate irrigation reforms with agricultural policy incentives.

Institutional Reforms
- Shift governance from administrative to **aquifer-based management**.
- Empower local user groups to prepare **water budgets**.

Technology and Monitoring
- Use **digital sensors, GIS mapping**, and real-time monitoring for tracking water levels and quality.

Economic Instruments
- Rationalise power subsidies and encourage **Direct Benefit Transfers** to reduce overuse.
- Introduce incentives for conservation and recharge activities.

Nature-Based Solutions
- Restore wetlands, lakes, and traditional tanks to enhance recharge.
- Mandate rainwater harvesting in urban buildings.

Climate-Resilient Planning
- Integrate groundwater management with **climate adaptation strategies**.
- Promote resilient crops and soil moisture conservation.

Conclusion
India's groundwater crisis calls for **scientific planning, policy reform, and community stewardship** to ensure long-term water security. Balancing **extraction with recharge** and

strengthening governance will be key to protecting this invisible but vital resource.

POLLUTER PAYS PRINCIPLE AND DELHI–NCR AIR POLLUTION

SOURCE: THE HINDU

Why in News?

Delhi–NCR continues to face **severe air pollution**, with high levels of **PM2.5, NOx, benzene, and CO** affecting public health. Debate has intensified over whether the **Polluter Pays Principle (PPP)** is being fairly applied, as blame is often placed mainly on farmers rather than all pollution sources.

Polluter Pays Principle: Meaning and Legal Basis

- PPP requires that those responsible for pollution should bear the **costs of prevention, control, and remediation**.
- Recognised by the Supreme Court in **Vellore Citizens Welfare Forum (1996)** as part of Indian environmental law.
- Reflected in the functioning of the **National Green Tribunal (NGT)** and environmental compensation mechanisms.
- Objective: **Internalisation of environmental costs** and deterrence against pollution.

Challenges in Applying PPP to Delhi–NCR

Multiple Pollution Sources

- Major contributors include **vehicular emissions**, thermal power plants, industries, construction dust, and open waste burning.

- Crop-residue burning contributes seasonally but is **not the sole driver** of year-round pollution.

Point vs Non-Point Sources

- Vehicles and small-scale construction are **diffuse sources**, making attribution of liability difficult.
- Precise measurement of each source's share requires advanced **source-apportionment studies**.

Seasonal Variability

- Winter inversion conditions trap pollutants, worsening air quality regardless of source.

Transboundary Character

- Pollutants move across State borders, limiting the effectiveness of action by one jurisdiction alone.

Principle of Proportionality in Liability

- International jurisprudence emphasises that liability must match **actual contribution**.
- Holding a single group responsible for a problem caused by **multiple actors** undermines fairness.
- In the Indian context, this suggests that farmers, industries, and urban transport systems must all share responsibility proportionately.

Transboundary Nature of Air Pollution

- Air pollution does not respect political boundaries; emissions from one region affect others.
- Scientific studies show PM2.5 travels long distances, causing regional health impacts.
- International norms recognise that managing such pollution requires **cooperative regional action**, not isolated blame.

Shift Towards a Government-Pays Approach

- Courts often direct governments to undertake pollution control, compensation, and mitigation.
- Victims lack resources to sue individual polluters, so the **State becomes the primary actor**.
- While this ensures quicker relief, it reduces direct accountability of polluting entities.

Role of the State and Administrative Constraints

- India has strong legal frameworks: **Air Act 1981, Environment Protection Act 1986**, and constitutional duties under **Articles 48A and 51A(g)**.
- However, pollution control boards face **staff shortages, monitoring gaps, and weak enforcement**.
- Regulatory fragmentation between States further complicates implementation.

Judicial Activism and Welfare Considerations

- Courts have taken proactive steps to protect the **right to life under Article 21**.

- Orders often prioritise public health over strict legal attribution of liability.
- However, over-reliance on government action risks weakening the **deterrent effect** of PPP.

Way Forward

Scientific Attribution

- Institutionalise regular **source-apportionment studies** to determine proportional contributions.

Shared Responsibility Framework

- Move from blame-centric to **collective accountability** involving transport, industry, agriculture, and households.

Market-Based Instruments

- Use pollution charges, emission trading schemes, and congestion pricing to internalise costs.

Support for Farmers

- Provide subsidies, machinery, and alternative crop-residue management methods instead of punitive fines.

Regional Cooperation

- Strengthen coordination among NCR States and neighbouring regions for joint action.

Strengthen Institutions

- Improve capacity and autonomy of pollution control bodies.

Long-Term Structural Solutions

- Expand public transport, electric mobility, clean fuels, and urban planning reforms.

Conclusion

The **Polluter Pays Principle** in India has gradually shifted towards a **government-funded response**, ensuring short-term relief but weakening accountability. Effective air-quality management in Delhi–NCR requires **proportional liability, scientific assessment, and cooperative governance** to balance justice and sustainability.

LAND DEGRADATION

TRANSFORMING A WASTE-RIDDEN URBAN INDIA

SOURCE: INDIAN EXPRESS

Why in News?

Indian cities are witnessing a **sharp rise in solid waste**, landfill fires, and methane emissions, bringing waste management into the centre of **urban and climate policy** debates.

Current Status of Urban Waste

- **High daily generation**: Cities generate over **1.7 lakh tonnes of municipal solid waste (MSW) per day**.
- **Treatment gap**: Only around **55–60%** of waste is scientifically processed; the rest ends up in dumpsites.
- **Future surge**: Annual MSW may exceed **160 million tonnes by 2030** and nearly triple by mid-century with expanding urban populations.
- **Pollution linkages**: Landfill fires, open burning, and leachate worsen **air pollution and groundwater contamination**.
- **Infrastructure stress**: Existing dumpsites are saturated, posing **health and safety hazards**.

Reasons Behind the Growing Crisis

- **Urban expansion outpacing systems**: Municipal capacity has not grown in line with population.
- **Consumption-heavy lifestyles**: Packaged goods, e-commerce, and fast replacement cycles increase waste.
- **Poor source segregation**: Mixing of wet and dry waste reduces recycling efficiency.
- **Financial and manpower shortages** in Urban Local Bodies (ULBs).
- **Plastic-dominated dry waste** with low recycling value.
- **Weak circular supply chains** and low demand for recycled products.
- **Enforcement gaps** in Extended Producer Responsibility (EPR) and C&D waste rules.

Key Challenges

- Continued reliance on **landfills and open dumps**.
- **Plastic waste management** complexity.
- Illegal dumping of **construction and demolition (C&D) waste** (~12–15 million tonnes annually).
- Limited **recycling and composting infrastructure**.
- Weak **wastewater reuse and faecal sludge management**.
- Poor **data, testing, and quality standards** for recycled materials.
- Fragmented governance among multiple departments.

Impacts of the Waste Crisis

- **Health risks**: Respiratory illness, vector-borne diseases, contaminated water.
- **Climate impact**: Organic waste decomposition releases **methane**, a potent greenhouse gas.
- **Environmental degradation**: Soil and groundwater pollution, marine plastic leakage.

- **Economic loss**: Recoverable materials and energy are wasted.
- **Urban quality decline**: Affects tourism, investment, and liveability.

Major Initiatives

- **Swachh Bharat Mission (Urban 2.0)**: Focus on garbage-free cities and dumpsite remediation.
- **Swachh Survekshan**: Incentivises segregation and processing.
- **Garbage Free Cities goal (2026)**.
- Promotion of **composting, bio-methanation, and Compressed Biogas (CBG)**.
- **Cities Coalition for Circularity (C-3)** for knowledge exchange.
- **C&D Waste Management Rules** with stricter compliance from 2026.
- **AMRUT and SBM** support wastewater recycling and reuse.

Way forward

Make Waste a Climate Priority

- Align urban waste management with **methane reduction and climate targets**.

Adopt Circular Economy

- Treat waste as **resource streams** for compost, energy, and materials.

Promote Mission LiFE

- Encourage **responsible consumption** and waste minimisation.

Expand Organic Waste Diversion

- Scale composting and **bio-methanation** to cut landfill loads.

Strengthen Dry Waste Systems

- Expand **Material Recovery Facilities (MRFs)** and recycling markets.

Enforce C&D Waste Rules

- Monitor bulk generators and penalise illegal dumping.

Integrate Wastewater Reuse

- Make treated wastewater a routine source for agriculture and industry.

Extend Producer Responsibility

- Cover all dry waste categories with strong monitoring.

Citizen Participation

- Incentivise segregation and recycling at the household level.

Conclusion

India's urban waste crisis threatens **health, environment, and climate stability**, demanding urgent systemic reform.

Building **circular cities** through segregation, recycling, accountability, and citizen action is essential for sustainable urban growth.

INDIAN INITIATIVES, EFFORTS AND COMMITMENTS

INDIA'S CLIMATE TARGETS: PROGRESS AND EMERGING GAPS

SOURCE: THE HINDU

Why in News?

Recent climate assessments indicate that while India has reduced the **emissions intensity of GDP**, its **absolute greenhouse gas emissions** continue to rise. This has revived debate on whether intensity-based progress is enough to meet long-term **climate stabilization goals**.

India's Key Climate Commitments

Under the **Paris Agreement**, India pledged to:

- Reduce **emissions intensity of GDP** by 33–35% from 2005 levels by 2030 (now overachieved).
- Achieve **50% cumulative installed power capacity from non-fossil sources** by 2030 (updated target).
- Expand renewable energy capacity (earlier 175 GW target; now over 500 GW non-fossil capacity aimed by 2030).
- Create an additional **carbon sink of 2.5–3 billion tonnes CO_2 equivalent** via forest and tree cover.

These commitments seek to balance **development needs** with **climate responsibility**.

Progress in Emission Intensity Reduction

India has made **substantial progress**:

By around 2020, emissions intensity fell by nearly **36% from 2005 levels**, achieving the earlier target ahead of schedule.

This success is driven by:

- **Rapid renewable expansion** (solar, wind, hydro, nuclear).
- Shift toward **services and digital sectors**, which are less carbon-intensive.
- **Energy efficiency schemes** like **PAT (Perform, Achieve and Trade)** and **UJALA LED programme**, reducing electricity demand growth.

However, this represents **relative decoupling** — emissions are rising more slowly than GDP, not declining in total.

Challenge of Rising Absolute Emissions

- India's total emissions remain high and continue to grow with economic expansion.
- Heavy industries such as **steel, cement, and transport** are major contributors.
- Coal remains central to energy security and industrial growth.
- India is among the **top global emitters in absolute terms**, though per capita emissions remain below the global average.

This shows the limitation of **intensity metrics**, which do not ensure a decline in **total emissions**.

Renewable Energy Expansion: Capacity vs Generation
Achievements

- Non-fossil power capacity has risen sharply, crossing **half of installed capacity** in recent years.
- **Solar power** has expanded dramatically due to falling tariffs and policy support.
- Domestic manufacturing and large solar parks have strengthened the clean energy base.

Key Concern

- Non-fossil sources contribute a much smaller share of **actual electricity generation** compared to their installed capacity.
- **Coal still dominates generation** because it provides reliable **baseload power**.
- Major bottlenecks:
    - **Energy storage shortages**
    - Grid integration challenges
    - Land and regulatory issues affecting wind projects

Thus, capacity growth has not fully translated into **generation decarbonisation**.

Forest Carbon Sink: Quantity vs Quality

- India appears close to its carbon sink target numerically.
- However, concerns exist regarding:
    - Broad definitions of forest cover including **plantations and monocultures**.
    - Limited focus on **biodiversity-rich natural forests**.
    - Underutilisation of funds under the **Compensatory Afforestation framework** in several states.
    - **Climate stress** (heatwaves, water scarcity) affecting forest health.

This raises questions about **ecological quality** versus **statistical carbon accounting**.

Structural Gaps in Climate Strategy

- Continued reliance on **coal for energy security**.
- Slow decarbonisation of **hard-to-abate sectors** (cement, steel, heavy transport).
- Storage and grid infrastructure lagging behind renewable expansion.
- Urbanisation and rising consumption increasing energy demand.

Way Forward

- Shift focus from only intensity reduction to **absolute emission moderation**.
- Accelerate **energy storage**, green hydrogen, and smart grids.
- Promote **low-carbon industrial processes** and electrification of transport.
- Improve **forest governance**, prioritising native species and ecosystem health.
- Strengthen **carbon markets and climate finance mobilisation**.
- Encourage **demand-side behavioural change** under sustainable lifestyle initiatives.

Conclusion

India has made strong progress in reducing **emissions intensity**, reflecting structural and policy gains. The next challenge is translating these gains into **real, sustained cuts in total emissions** while continuing inclusive economic growth.

DISASTER MANAGEMENT

HIMALAYAN DISASTERS AND FRAGILE DEVELOPMENT

SOURCE: DOWN TO EARTH

Why in News?

India witnessed **frequent Himalayan disasters** recently, including landslides, flash floods and cloudbursts, highlighting the rising **climate vulnerability** of mountain ecosystems.

Why Are Himalayan Disasters Increasing?
Rapid Warming in Mountains

- The Himalayan region is warming **faster than the global average**, altering snow patterns and glacier stability.
- **Snowline shifts**, reduced winter snowfall and faster glacial melt increase water flow variability.

Rise in Extreme Weather

- More frequent **cloudbursts, intense rainfall and heat waves** destabilise slopes.
- Sudden precipitation on loose terrain triggers **landslides and flash floods**.

Glacial Retreat and GLOFs

- Many glaciers are retreating, forming **unstable glacial lakes** dammed by loose moraines.
- Breach of these lakes leads to **Glacial Lake Outburst Floods**, as seen in recent Himalayan events.

Geological Fragility

- The Himalayas lie along active fault systems like the **Main Central Thrust (MCT)**.
- Construction in such zones increases **seismic and landslide risks**.

Governance and Infrastructure Issues

Unsuitable Road Design

- Wide highways and heavy slope cutting disturb natural slope balance.
- Vertical hill cutting ignores the **natural angle of repose**, triggering collapses.

Hydropower and Tunnelling

- Blasting and tunnelling alter underground water channels, weakening rock mass stability.
- Reservoirs increase **slope saturation**, raising landslide probability.

Bypassing Environmental Safeguards

- Large projects are often split into smaller segments to avoid full **Environmental Impact Assessment (EIA)** scrutiny.
- **Muck dumping** into rivers blocks natural drainage.

Forest Diversion

- Clearance of mountain forests removes **natural slope binders** and increases erosion.

Ecological and Human Implications

Human Losses and Displacement

- Recurrent floods and landslides destroy **villages, roads and livelihoods**, causing migration.

Damage to River Systems

- Sediment load from landslides alters river courses and increases **flood risks downstream**.

Loss of Biodiversity

- Alpine meadows and forests host unique species; habitat fragmentation weakens ecosystems.

Threat to Water Security

- The Himalayas are India's **water tower**; ecological damage affects Ganga, Brahmaputra and Indus basins.

ON THE RISE
The Himalayan states experienced over 40 per cent of India's disasters in 2013-22
Number of disaster events in
Himalayan states / in India

Why Devdar Forests Matter

- **Devdar (Cedrus deodara)** roots bind soil and stabilise slopes.
- Forest canopy reduces rainfall impact and **slows surface runoff**.
- Forest litter improves soil structure and water absorption.
- Removal of such forests raises risks of **debris flows and avalanches**.

Policy and Planning Gaps

- Weak implementation of the **National Mission for Sustaining the Himalayan Ecosystem (NMSHE)**.
- Limited **carrying capacity studies** before tourism or road expansion.
- Disaster management remains **reactive** rather than preventive.
- Poor inter-agency coordination among environment, power, roads and tourism authorities.

Way Forward

Adopt Disaster-Resilient Development

- Prioritise **slope stability** over road width.
- Use bio-engineering and retaining structures.

Science-Based Land Use

- Strict zoning based on **geological sensitivity maps**.
- Avoid construction in high-risk zones.

Strengthen Forest Protection

- Conserve **old-growth Himalayan forests** as natural disaster buffers.
- Promote native species restoration.

Improve Governance

- Mandatory cumulative impact assessments.
- Monitor muck disposal and tunnelling activities.

Climate Integration

- Treat climate change as a **risk multiplier** in all planning.
- Strengthen early warning for landslides and GLOFs.

Community-Centric Planning

- Involve local communities in monitoring, afforestation and tourism management.

Conclusion

The Himalayas are India's **ecological shield and water source**, but climate change and unplanned development are turning them into disaster hotspots. Only **science-led, forest-protective and risk-sensitive development** can secure both national infrastructure and long-term environmental stability.

PRELIMS POINTERS IN NEWS

DARWIN'S BARK SPIDER

SOURCE: THE HINDU

Why in News?

An international team of scientists has recently studied **Darwin's bark spiders** to understand how environmental conditions influence production of their **exceptionally tough silk**.

Taxonomy and Discovery

- Belongs to the **family Araneidae** (orb-weaver spiders).
- Species first identified in **Madagascar** in the early 2000s and formally described in **2009**.
- Named after **Charles Darwin** due to its extraordinary evolutionary adaptation.

Habitat and Distribution

- Found mainly in **Madagascar's riverine forests and wetlands**.
- Prefers areas over **rivers, lakes, and streams**, unlike most spiders that build webs in vegetation.
- This unusual habitat helps capture **aquatic and flying insects**.

Physical Features

- **Sexual dimorphism** is prominent:
  - Females: about **2–2.5 cm** body length.
  - Males: much smaller.
- Body colour is **dark brown with mottled patterns**, enabling camouflage on tree bark.

Unique Web-Building Ability

- Constructs **giant orb webs** that can stretch **up to 25 metres (≈82 feet)** across water bodies.
- Anchor lines are attached to trees on opposite banks, forming **bridging structures**.
- Considered the **largest orb webs** made by any spider species.

Extraordinary Silk Properties

- Produces silk with **exceptional toughness** — ability to absorb energy before breaking.
- Research shows its silk is **stronger and more flexible** than most other spider silks studied.
- Combines **high tensile strength and elasticity**, a rare combination in natural fibres.
- Scientists believe **humidity, diet, and habitat stress** influence silk performance.

INDIAN SKIMMER

SOURCE: THE HINDU

Why in News?

The **BNHS**, in collaboration with the **National Mission for Clean Ganga (NMCG)**, has initiated a conservation project to protect the **Indian Skimmer** in the **Ganga river basin**. The move aims to safeguard this **endangered riverine bird** whose breeding habitats are rapidly declining.

Taxonomy and Distribution

- Belongs to the genus **Rynchops** in the gull family **Laridae**.
- One of only **three skimmer species** globally.
- Native to **South Asia** — mainly **India, Bangladesh, Pakistan**, with occasional presence in **Nepal and Myanmar**.
- In India, major habitats include the **Chambal, Ganga, Mahanadi, and Brahmaputra** river systems.

Habitat

- Prefers **wide, sandy rivers** with exposed sandbars for nesting.
- Also uses **lakes, wetlands, and marshes**.

- During non-breeding season, may move to **estuaries and coastal areas**.

Physical Features

- Medium-sized bird with **black upperparts** and **white underparts**.
- Most distinctive trait: **bright orange beak** where the **lower mandible is longer** than the upper one.
- Long, pointed wings allow **low, fast flight** over water.

Unique Feeding Behaviour

- Flies just above the water with its lower beak slicing through the surface.
- Detects fish by touch and snaps its beak shut — a method called **"skimming."**

Conservation Status

- **IUCN Red List: Endangered**.
- Population declining due to **loss of breeding habitats**.

Major Threats

- **Sand mining** that destroys nesting sandbars.
- **Dam operations** causing sudden water level fluctuations.
- **River pollution** and human disturbance.
- Predation on eggs and chicks by stray animals.

SALTWATER CROCODILE

SOURCE: THE HINDU

Why in News?

A recent **drone-based survey by Odisha Forest Department** has recorded a rise in the **Saltwater Crocodile population** in the state. The findings highlight the success of **mangrove conservation and crocodile protection programmes**.

Saltwater Crocodile

- The **Saltwater Crocodile (*Crocodylus porosus*)** is the **largest living reptile** on Earth.
- Commonly called **estuarine crocodile, sea crocodile, or "saltie."**

- It is a **top predator** and plays a crucial role in maintaining **wetland ecosystem balance**.

Habitat and Distribution

- Found in **coastal estuaries, mangrove swamps, tidal rivers, and brackish wetlands**.
- Global range spans **India's east coast, Southeast Asia, Indonesia, Papua New Guinea, and northern Australia**.
- In India, major populations occur in **Odisha (Bhitarkanika region), West Bengal (Sundarbans), and Andaman & Nicobar Islands**.
- **Odisha hosts the largest wild population** in the country.

Physical and Behavioural Features

- Adult males can exceed **6 metres in length** and weigh over **1,000 kg**.
- Known for **strong territorial behaviour**, especially among dominant males.
- They are **solitary hunters** and opportunistic feeders, preying on fish, birds, mammals, and occasionally large animals.
- Capable of surviving in both **freshwater and marine environments** due to special salt-regulating glands.

Conservation Status and Efforts

- **IUCN Status: Least Concern** globally, but regionally monitored.
- Protected under **Schedule I of the Wildlife Protection Act, 1972** in India.
- Odisha's **Bhitarkanika National Park** is a key conservation site.
- Use of **drone monitoring** improves population tracking and habitat surveillance.

IRRAWADDY DOLPHIN

SOURCE: THE HINDU

Why in News?

The **Ministry of Environment, Forest and Climate Change** has initiated the **second nationwide survey of riverine and estuarine dolphins** under **Project Dolphin**.

Habitat & Distribution

- Prefers **shallow coastal waters**, **muddy estuaries**, and **deltas** rather than open oceans.
- Global riverine populations occur in:
    - **Irrawaddy River (Myanmar)**
    - **Mahakam River (Indonesia)**
    - **Mekong River (Cambodia & Laos)**
- **India:** Mainly found in **Chilika Lake (Odisha)** and parts of the **Sundarbans delta**.
- Thrives in **brackish ecosystems**, making it ecologically distinct from purely marine dolphins.

Physical Features

- Recognised by a **rounded head** with **no distinct beak**.
- Body colour is **grey**, lighter underneath.
- Possesses a **small dorsal fin** and **large rounded flippers**.
- Flexible neck creases allow **greater head movement**.
- Teeth are **small, peg-like**, suited to catching fish and crustaceans.

Ecological Importance

- Acts as an **indicator species** for estuarine and coastal ecosystem health.
- Maintains **fish population balance** and supports aquatic biodiversity.
- Presence reflects the quality of **brackish water habitats**.

Conservation Status & Threats

- **IUCN Status: Endangered**.
- Major threats include:
    - **Habitat degradation** due to coastal development
    - **Fishing net entanglement** (bycatch)
    - **Water pollution** and vessel traffic
    - **Climate change** affecting salinity and prey availability

Government Initiatives

- **Project Dolphin** focuses on protection of both **riverine and marine dolphins**.
- Population surveys, habitat monitoring, and community awareness are key strategies.
- Conservation overlaps with **wetland protection** and **coastal regulation** efforts.

ROYLE'S PIKA

Why in News?

Scientists have warned that **climate change** is threatening high-altitude species like **Royle's pika**, which are highly adapted to cold mountain ecosystems.

Habitat & Distribution

- Found in **rocky slopes, talus zones, and rhododendron forests**.
- Altitudinal range: **2,400–5,000 metres** above sea level.
- Distributed from **north-western Pakistan** across **Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh**, extending into **Nepal and Tibet**.

Key Characteristics

- Small, round-eared mammal with **dense fur** for insulation.
- **Does not hibernate**; remains active even during winter.
- Relies on **thick snow cover** as a natural insulating layer against extreme cold.
- Uses **natural rock crevices and burrows** rather than digging its own nests.

Diet & Reproduction

- Feeds mainly on **alpine herbs, grasses, and forbs**, especially moisture-loving Himalayan plants.
- Known to store vegetation (haypiling) for winter survival.
- **Breeding season:** Late spring to summer.
- Attains **sexual maturity** at around **7–10 months**.

Conservation Status & Ecological Role

- **IUCN Status: Least Concern**.
- Acts as a **prey species** for high-altitude predators and contributes to **nutrient cycling** through vegetation clipping.

GEGENEOPHIS VALMIKI

Why in News?

Indian researchers have discovered a new **subterranean amphibian species** in the **northern Western Ghats of Maharashtra** named **Gegeneophis valmiki**.

Taxonomic Position

- **Genus:** *Gegeneophis*
- Common group name: **Blind caecilians**
- Named in honour of the **Valmiki temple** near the discovery location.
- First new species added to this genus in over a decade.

Habitat & Distribution

- Found in the **northern Western Ghats**, Maharashtra.
- Lives underground in **moist soil and forest floor ecosystems**.
- Prefers **tropical, high-rainfall environments** with rich soil cover.

Physical & Biological Features

- **Limbless, elongated body**, resembling an earthworm.
- **Eyes are covered by skin and bone**, reducing vision.
- Lacks vocal calls typical of frogs and toads.
- Uses **tentacle-like sensory organs** to detect prey underground.

Ecological Importance

- **Soil engineers**: Burrowing improves **soil aeration and nutrient mixing**.
- Feed on **invertebrates**, regulating soil fauna.
- Serve as prey for **birds, reptiles, and small mammals**.
- Represent an important **evolutionary link** among amphibians.

Caecilian Diversity

- Globally, caecilians form a **small fraction of amphibians**.
- India is a major centre of caecilian diversity, especially in the **Western Ghats**.
- Many species are **endemic**, indicating high conservation value.

Conservation Concerns

- Threats include **habitat loss, deforestation, and soil disturbance**.
- Climate change may alter **soil moisture patterns**, affecting survival.
- Limited research and difficulty in detection hinder conservation planning.

PUFFERFISH

Why in News?

Scientists have reported **India's first confirmed case of pufferfish poisoning**, raising awareness about the risks from toxic marine and freshwater species.

Habitat & Distribution

- Found in **marine, brackish, and freshwater** ecosystems.
- Many Indian freshwater species occur in river systems and are **regionally endemic**.
- Occupy **benthic zones**, feeding near the bottom.
- Serve as **ecological indicators** of river health in some regions.

Key Biological Features

- Can **inflate like a balloon** to deter predators.
- Some species have **spiny skin** that becomes prominent when inflated.
- Omnivorous diet: **algae, invertebrates, and small organisms**.
- Slow swimmers but protected by **toxin and defence behaviour**.

Conservation Aspects

- Several species face pressure from **habitat degradation and pollution**.
- Some are traded in the **ornamental fish market**.
- Conservation status varies by species; certain freshwater pufferfish are considered **vulnerable due to restricted habitats**.

Pufferfish Poisoning

- Caused by **tetrodotoxin (TTX)**, a powerful **neurotoxin**.
- TTX blocks **sodium channels in nerves**, leading to **paralysis and respiratory failure**.
- The toxin is **heat-stable**, meaning cooking does not destroy it.
- Symptoms include **numbness, dizziness, muscle weakness**, and severe cases may be fatal.
- The toxin is believed to be produced by **symbiotic bacteria**, not by the fish itself.

DROSOPHILA MELANOGASTER

SOURCE: THE HINDU

Why in News?

Scientists recently examined the **ovaries of Drosophila melanogaster** to understand how **reproductive stem cells maintain function over time**.

Habitat & Distribution

- Originally from **tropical regions of the Old World**.
- Now found in **temperate and tropical zones worldwide**.
- Thrives in **human-associated environments** where decaying fruits are present.

Food & Behaviour

- Feeds mainly on **rotting fruits and plant material**.
- Attracted strongly to **fermenting smells** due to sensitive olfactory receptors.

Reproductive Features

- **Rapid reproduction**: Eggs hatch quickly and life cycle completes in about **10–14 days** under optimal conditions.
- Offspring reach **sexual maturity in about a week**.
- Undergoes **complete metamorphosis**: egg → larva → pupa → adult.

Physical Characteristics

- Body covered by a **chitinous exoskeleton**.
- Three body parts: **head, thorax, abdomen**.
- Possesses **three pairs of legs** and **compound eyes** sensitive to light changes.
- **Sexual dimorphism** allows easy identification of males and females.

Scientific Importance

- Shares many **genetic similarities with humans**.
- Used in studies on **genetics, ageing, neuroscience, and disease mechanisms**.
- Research on its **stem cells** helps understand fertility and tissue maintenance.

Advantages as a Model Organism

- Easy to culture in laboratories.
- Small genome with well-mapped genes.
- Ethical and cost advantages compared to vertebrate models.

RIGHT TO A HEALTHY ENVIRONMENT

Recently, the **Commission for Air Quality Management (CAQM)** revised the **Graded Response Action Plan (GRAP)** to mandate **school closures in high-pollution phases** along with staggered office timings aiming to curb worsening air quality.

Persistent Environmental Crises in India

1. Severe Air Pollution

- India remains among the world's **most polluted countries**, with several cities frequently recording hazardous air quality levels.

- The industrial town of **Byrnihat** was ranked the **world's most polluted city in 2024** with PM2.5 vastly above safe limits.
- Air pollution reduces life expectancy by **up to 8 years in Delhi** and contributes to **cardiovascular, respiratory and systemic health issues**.

2. Water Scarcity and Pollution

- Groundwater tables are declining nationwide, with many districts extracting water from depths beyond 40 m.

- Pollution of rivers and aquifers persists due to untreated sewage, industrial discharge, and agricultural runoff. The **2025 Indore water contamination incident** underscores how even well-managed cities can face dire water quality crises.

3. Biodiversity and Habitat Loss

- Critical ecosystems like **wetlands, forests, and coastal regions** are under pressure from urban expansion and land conversion.
- Biodiversity hotspots such as the **Western Ghats** and the Himalayas face increasing fragmentation and species decline.

4. Soil Degradation

- Overuse of chemical fertilisers and unsustainable practices have reduced soil nutrient levels and fertility significantly.
- This degrades agricultural productivity and exacerbates food security risks.

5. Waste Management Crisis

- India generates tens of millions of tonnes of waste annually including **plastic, e-waste, biomedical and hazardous waste**.
- Poor waste segregation and disposal lead to landfill overflows, burning of waste, soil and water contamination.

Graded Response Action Plan (GRAP)

- **GRAP** is an **emergency pollution control mechanism** for the National Capital Region (NCR), instituted under the Supreme Court's direction in 2016 to proactively manage deteriorating air quality.
- It operates in **four stages** based on the **Air Quality Index (AQI)**:
    - **Stage I – Poor**,
    - **Stage II – Very Poor**,
    - **Stage III – Severe**,
    - **Stage IV – Severe+** (includes school closures and heavy traffic restrictions).
- Recent amendments now make **closure of schools mandatory in Phases III and IV**, strengthening response to extreme smog events.

Commission for Air Quality Management (CAQM)

- Established under the **Commission for Air Quality Management Act, 2021**, CAQM is the apex authority for air quality regulation in NCR and adjoining states.

- It coordinates pollution mitigation across **multi-state jurisdictions** and is directly accountable to Parliament.
- The Chairperson must have high expertise in environmental management or administrative leadership.
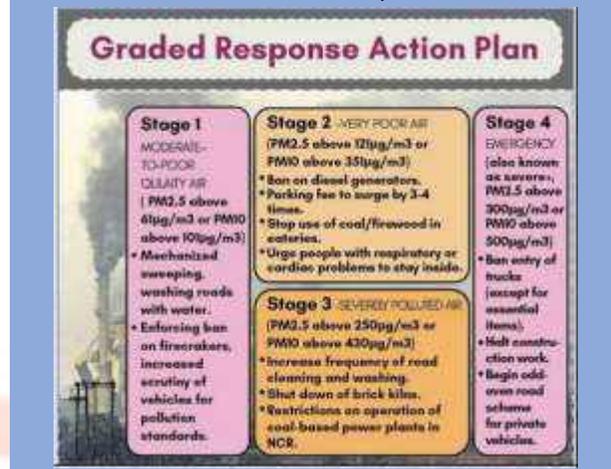
Key Conservation Initiatives

- **Air & Water:** National Clean Air Programme (NCAP), GRAP, Jal Jeevan Mission, Namami Gange.
- **Biodiversity:** Wildlife Acts, Project Tiger & Elephant, Biological Diversity Act.
- **Waste:** Plastic & E-Waste Management Rules, Swachh Bharat Mission.
- **Climate:** Paris Agreement commitments, International Solar Alliance, LiFE (Lifestyle for Environment).
- **Monitoring & Tech:** Environmental Impact Assessment (EIA), National Green Tribunal (NGT), satellite-based monitoring.

Challenges in Addressing the Crisis

- **Governance gaps:** Enforcement remains uneven with weak penalties and compliance.
- **Development pressure:** Infrastructure, mining and urban expansion often override ecological safeguards.
- **Technical complexities:** Multi-state air pollution and climate extremes demand coordinated governance.
- **Behavioural hurdles:** Low public adoption of environment-friendly practices.

Way Forward

- **Constitutional Reform:** Insert Right to a Clean and Healthy Environment as a non-derogable fundamental right.
- **Institutional Strengthening:** Create a **National Environmental Authority** for effective inter-sectoral coordination.

- **Data-Driven Governance:** Use AI and satellite monitoring (e.g., ISRO ENVIS) for real-time compliance tracking.
- **Economic Tools:** Implement carbon pricing, green bonds, redirect fossil subsidies to renewables, and enforce mandatory environmental CSR spending.
- **Global Cooperation:** Secure technology transfer and climate finance commitments.

Conclusion

India's environmental crisis is **systemic and urgent**, affecting health, ecology and development. While judicial interpretations and policy frameworks exist, strong **constitutional protection**, integrated governance, and **technology-driven enforcement** are essential to transform reactive measures into sustained ecological resilience. Robust action now will determine the nation's environmental future.

High Cost and Scaling Issues

- Research equipment and production processes are expensive.
- Difficulty in moving from lab innovation to large-scale clinical use.

Steps for Safe and Sustainable Adoption

- **Safety-focused R&D:** Study long-term biological and environmental effects.
- **Green Nanotechnology:** Develop biodegradable and non-toxic materials.
- **Strong Regulation:** Update health policies and create nano-specific guidelines.
- **Ethical Governance:** Ensure privacy protection and equitable access.
- **Clinical Translation Support:** Fund trials and build collaboration between scientists and doctors.
- **Environmental Monitoring:** Track nanoparticle release and disposal.

Conclusion

Magnetic nanorobots represent a breakthrough in **targeted, minimally invasive treatment**, especially for cancer. Their safe and widespread use will depend on **robust safety research, clear regulation and ethical governance** to ensure that nanomedicine benefits society responsibly.

ANTIMICROBIAL RESISTANCE (AMR): A SILENT PANDEMIC

SOURCE: THE HINDU

Why in News?

The Prime Minister recently stressed **responsible use of antibiotics**, drawing attention to the rising danger of **Antimicrobial Resistance (AMR)**. Growing treatment failures and drug-resistant infections have made AMR a major **public health emergency**.

Major Challenges Driving AMR

Misuse and Overuse of Antibiotics

- Antibiotics are often taken for **viral illnesses** where they have no effect.
- Patients frequently stop medication once symptoms subside, allowing **resistant strains** to survive.
- Hospitals rely heavily on **broad-spectrum drugs**, increasing selective pressure on microbes.

Low Public Awareness

- Many people lack understanding of **dosage completion** and dangers of self-medication.

- Informal healthcare providers and chemists sometimes recommend antibiotics without prescriptions.

Weak Diagnostic Systems

- Limited access to **laboratory testing** in rural areas leads to empirical prescriptions.
- Absence of rapid diagnostics encourages "trial-and-error" antibiotic use.

Inadequate Surveillance

- National data on resistant organisms is **fragmented**.
- Lack of real-time monitoring reduces the ability to track emerging threats.

Limited R&D Investment

- Developing new antibiotics is **costly** and less profitable than chronic-disease drugs.
- The pipeline of novel antimicrobials remains thin.

Regulatory Gaps

- Despite rules restricting sale, many pharmacies provide antibiotics **over the counter**.
- Enforcement of stewardship guidelines remains inconsistent.

How antibiotic resistance occurs

1. Bacteria cells in the human body; some are drug resistant
2. Antibiotics kill bacteria but resistant strains remain
3. Antibiotic-resistant bacteria multiply
4. Antibiotic resistance spreads

Normal bacteria | Resistant bacteria | Dead bacteria
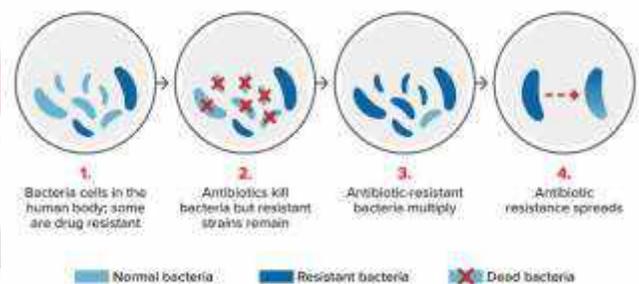
Health and Economic Implications

- **Longer hospital stays** and higher treatment costs.
- Increased risk of **surgical complications** and infections in immunocompromised patients.
- Threat to procedures like chemotherapy, organ transplants, and neonatal care.
- AMR could slow economic growth due to productivity loss.

Way Forward

Strengthen Public Awareness

- Launch campaigns on **rational antibiotic use**.
- Use ASHA workers and primary health centres for community outreach.

Improve Diagnostics

- Upgrade district hospitals with **microbiology labs**.
- Promote **point-of-care tests** to guide prescriptions.

Capacity Building

- Include **antimicrobial stewardship** in medical training.

- Conduct regular audits of prescription practices.

Stronger Regulation

- Enforce prescription-only sale of antibiotics.
- Use **digital tracking systems** for drug distribution.

Boost Research and Innovation

- Provide funding and incentives for **new drug development**.
- Support vaccine research to reduce infection burden.

Expand Surveillance

- Strengthen the **National AMR Surveillance Network**.
- Ensure data sharing between hospitals and research labs.

Adopt One Health Approach

- Monitor antibiotic use in **livestock and agriculture**.
- Control pharmaceutical waste in the environment.

Conclusion

AMR threatens to make common infections untreatable, undermining decades of medical progress. A mix of **awareness, regulation, diagnostics, research, and One Health coordination** is vital to protect future generations.

SPACE TECHNOLOGY

PSLV SETBACKS AND INDIA'S SPACE RELIABILITY CHALLENGE

### SOURCE: THE HINDU

Why in News?

ISRO is under focus after **two back-to-back PSLV mission failures** reportedly linked to issues in the **third stage (PS3)**. The setbacks have sparked debate over **quality control, strategic space assets, and India's commercial launch credibility**.

What is PSLV? – India's Workhorse Rocket

- **Type**: Four-stage launch vehicle using a mix of **solid and liquid propulsion**.
- **Operational since**: 1990s; backbone for **LEO and Sun-Synchronous Orbit missions**.
- **Stages**:
    - **PS1** – Solid motor for lift-off thrust.
    - **PS2** – Liquid Vikas engine for controlled ascent.
    - **PS3** – Solid stage for high-altitude acceleration.

- **PS4** – Liquid stage for precise orbital insertion.
- **Uses**: Earth observation, navigation satellites, interplanetary probes, and foreign commercial payloads.
- Known for **mission versatility and cost-effectiveness**.
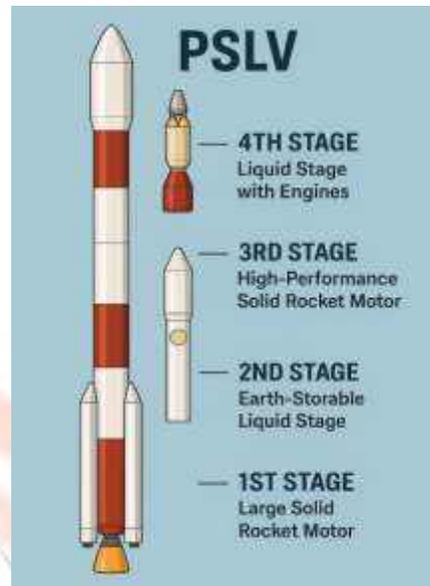
Nature of Recent Failures

Common Technical Pattern

- Both incidents reportedly involved anomalies during **PS3 operation**, a **solid rocket motor** stage.
- Solid motors cannot be shut down mid-flight; hence **manufacturing precision is critical**.
- Possible causes include **propellant defects, uneven burning, or structural material stress**, leading to loss of stability or thrust imbalance.
- Similar stage-linked issues suggest a **systemic rather than random failure**.

Why This Matters

1. Strategic Implications

- PSLV frequently deploys **Earth Observation Satellites (EOS)** used for **border monitoring, disaster management and surveillance**.
- Delays in replacing such assets can create **temporary intelligence gaps**.
- As defence increasingly depends on space-based data, launcher reliability becomes a **national security concern**.

2. Commercial Reputation

- Through **NewSpace India Ltd. (NSIL)**, India markets PSLV as a **reliable small-satellite launcher**.
- Global clients prioritise **mission assurance over price**, especially after launch insurance costs rise following failures.

- Competitors like **SpaceX and other dedicated small-launch firms** dominate rideshare markets, so reputational setbacks can affect future contracts.

3. Quality Control and Industrial Transition

- PSLV production now involves greater participation of **Indian industry consortia**.
- Transfer of complex propulsion manufacturing demands **strict quality audits and process standardisation**.
- Dependence on imported **electronics, composites and semiconductors** exposes supply chains to global disruptions.

Systemic Issues Highlighted

- **Solid propulsion sensitivity**: Minor flaws can produce large in-flight instability.
- **Aging design with new industrial ecosystem**: Transition from ISRO-led to industry-led manufacturing requires deeper oversight.
- **Testing vs. operational tempo**: Growing launch frequency can compress quality cycles if not managed carefully.
- **Insurance and trust**: Space insurance premiums are directly linked to recent reliability data.

Way Forward

Reliability-First Engineering

- Temporarily prioritise **extensive testing and validation** over launch frequency.
- Introduce **block upgrades** and stage-level redesign where needed.

Transparent Failure Review

- Release findings of **Failure Analysis Committees** in a structured, time-bound manner (with sensitive data protected).
- Transparency builds confidence among **clients, insurers and partners**.

Strengthen Quality Ecosystem

- Independent third-party audits for propulsion manufacturing.
- Standardised quality protocols across all **industry suppliers**.

Diversify Launch Infrastructure

- Develop additional launch facilities to enhance **operational resilience** and reduce dependency on a single site.

Boost Indigenisation

- Accelerate domestic production of **space-grade electronics, materials and propulsion components**.
- Align with **Atmanirbhar Bharat** goals in high-technology sectors.

Integrate Strategic Space Planning

- Strengthen coordination between **civil, commercial and defence space programmes** to ensure redundancy in surveillance capabilities.

Conclusion

The recent PSLV setbacks underline that India's space journey has entered a phase where **credibility and consistency** are as vital as innovation. A **reliability-driven, transparent and industry-integrated approach** will help restore confidence and secure India's role as a trusted global space power.

EMERGING TECHNOLOGIES

BIOMATERIALS: THE NEXT FRONTIER IN SUSTAINABLE MANUFACTURING

SOURCE: THE HINDU

Why in News?

With global industries shifting toward **low-carbon and circular manufacturing**, biomaterials are emerging as key alternatives to fossil-based materials. This transition is creating new opportunities for countries like India to link **climate action, industry growth, and farm incomes**.

What are Biomaterials?

- **Definition:** Materials obtained fully or partly from **biological sources** or produced using biological processes, designed to replace or function alongside conventional materials.
- **Sectors of use:** Packaging, textiles, construction, medical devices, and consumer goods.
- **Examples:**
    - **Bioplastics** from starch, sugarcane or corn
    - **Bio-fibres** in clothing
    - **Medical biomaterials** like biodegradable sutures

Types of Biomaterials

- **Drop-in biomaterials:** Chemically similar to petroleum products; usable in existing systems (e.g., bio-PET).

- **Drop-out biomaterials:** Structurally different; need new processing or disposal systems (e.g., PLA).
- **Novel biomaterials:** Offer new features like **self-healing**, bioactivity, or smart responses.

Why Biomaterials Matter for India

- **Green Growth Strategy:** Aligns environmental protection with industrial development.
- **Reducing Import Dependence:** Cuts reliance on imported fossil-based plastics and chemicals.
- **Farmer Income Support:** Crop residues and biomass can become **industrial raw materials**, diversifying rural earnings.
- **Export Competitiveness:** Global markets are favouring **low-carbon products**, and biomaterials help Indian industries stay relevant.
- **Policy Synergy:** Supports bans on single-use plastics and India's **climate commitments**.

India's Current Position

- **Emerging sector:** India's biomaterials and bioplastics industry is expanding steadily.
- **Market growth:** The domestic bioplastics market is estimated at several hundred million dollars and is projected to grow rapidly this decade.
- **Major investments:** Large-scale PLA production projects in Uttar Pradesh mark a shift toward domestic manufacturing.
- **Start-up innovation:** Firms are converting agricultural and floral waste into packaging and fibres, showing circular economy potential.

Global Trends

- **European Union:** Strong packaging waste regulations promote compostable and recyclable biomaterials.
- **United States:** Uses government procurement policies to support bio-based products.
- **West Asia & others:** Investing in large PLA production facilities to become manufacturing hubs.
  These moves indicate a global race to dominate the **bio-based materials market**.

Key Challenges

- **Food vs feedstock conflict:** Large-scale use of crops may compete with food supply.
- **Water and soil stress:** Intensive biomass production can strain natural resources.
- **Infrastructure gaps:** Limited composting and recycling systems reduce environmental gains.
- **Policy fragmentation:** Agriculture, environment, and industry policies often lack coordination.

- **Technology dependence:** Advanced processing technologies are still partly imported.

Way Forward

- **Expand biomanufacturing capacity:** Invest in fermentation and polymer production facilities.
- **Sustainable feedstock management:** Use crop residues and improve yield efficiency.
- **Boost research and standards:** Develop indigenous technologies and certification systems.
- **Clear regulations and labelling:** Ensure consumer trust and proper end-of-life handling.
- **Government procurement support:** Use public demand to reduce risk for early investments.

Conclusion

Biomaterials offer India a pathway to combine **climate action, industrial self-reliance, and rural development**. With strong policy support, innovation, and sustainable practices, India can become a major player in the global **bio-economy**.

QUANTUM MECHANICS BEYOND THE ATOMIC SCALE

SOURCE: THE HINDU

Why in News?
The **2025 Nobel Prize in Physics** has been awarded for demonstrating **quantum behaviour in electrical circuits**, a breakthrough that strengthens the scientific foundation of quantum computing.

What is Quantum Tunnelling?

- **Quantum tunnelling** is a phenomenon where particles pass through an energy barrier even when classical physics says they lack sufficient energy.
- Instead of "climbing" a barrier, particles effectively **"pass through"** it.
- Common in **nuclear fusion, radioactive decay, and semiconductor devices**.
- The new discovery shows tunnelling can occur in a **macroscopic superconducting circuit**.

Josephson Junction: The Experimental Platform

Structure

- Consists of **two superconductors** separated by an ultra-thin insulating layer.
- Superconductors carry current with **zero resistance** via paired electrons (**Cooper pairs**).

Key Variable

- The **phase difference** between the superconductors acts as a **single collective**

quantum variable shared by trillions of electrons.

Objective

- To test whether this macroscopic variable could behave like a **quantum particle**.

Major Observations

Macroscopic Quantum Tunnelling

- At low current, electron pairs are "trapped," producing no voltage.
- Classically, this state would remain forever.
- But quantum mechanics allowed a **probability of tunnelling**, suddenly producing measurable voltage.
- Temperature tests confirmed this was **quantum tunnelling**, not thermal escape.

Energy Quantisation

- Microwaves were applied at varying frequencies.
- When the frequency matched the **energy gap between discrete levels**, the system escaped more easily.
- This showed the circuit had **distinct energy states**, like an atom.

Why Was the Experiment Difficult?

- Quantum states are extremely **fragile**.
- Even weak microwave radiation or temperature fluctuations can destroy quantum coherence.
- Scientists used:
  - **Ultra-low temperatures**
  - **Electromagnetic shielding**
  - Precision filtering systems
- Careful isolation allowed the circuit to retain **pure quantum behaviour**.

Scientific Significance

- Proved **quantum mechanics applies beyond atomic scales**.
- Established superconducting circuits as controllable **quantum systems**.
- Formed the theoretical and experimental basis for **superconducting qubits**, now widely used in quantum computing.

Applications

Quantum Computing

- Josephson junction circuits form the backbone of many **quantum processors** today.
- **Qubits** can exist in superposition, enabling parallel computation.
- Useful for:
  - Drug discovery and **molecular modelling**
  - Climate simulations

- Logistics optimisation
- Cryptography analysis

Quantum Cryptography & Security

- Quantum systems can both **break traditional encryption** and help design **quantum-secure communication**.

Precision Measurement

- Superconducting quantum devices improve **magnetic sensing**, astrophysics instruments, and fundamental physics experiments.

Relevance for India

- India launched the **National Quantum Mission (₹6,000 crore)** to develop quantum computers, communication systems, and sensors.
- Indigenous superconducting qubit research can reduce reliance on foreign technology.
- Supports **strategic sectors**: defence, secure communication, and high-performance computing.

Conclusion

This Nobel-winning work proved that **large-scale electrical systems can obey quantum laws**, laying the foundation for today's quantum technologies. By transforming theory into real devices, it has accelerated progress toward **quantum computing, secure communication, and advanced sensing**.

PRELIMS POINTERS IN NEWS

MOLECULAR CLOUD

SOURCE: INDIAN EXPRESS

Why in News?

Astronomers have analysed the **L328 molecular cloud**, about **700 light-years** away, to understand how **magnetic fields influence star formation**.

Physical Properties

- **Temperature:** Extremely cold, usually **below 40 Kelvin**.

- **Density:** Much denser than surrounding interstellar space.
- **Size:** Ranges from a few light-years to hundreds of light-years.
- **Mass:** Can contain **thousands to millions of solar masses** of material.
- Larger clouds (>15 light-years) are called **Giant Molecular Clouds (GMCs)**.

Structure

- Central regions are **opaque due to dust**, blocking visible light.
- Dust grains help shield molecules from radiation and aid in **molecule formation**.
- Contain clumps and cores where **star formation begins**.

Forces Governing Evolution

Star formation depends on the balance of:

- **Gravity** – pulls gas inward.
- **Magnetic fields** – regulate collapse and gas flow.
- **Turbulence** – causes fragmentation into smaller regions.

Life Cycle

- Collapse of dense regions forms **protostars**.
- Newly formed stars emit **radiation and stellar winds**, dispersing leftover gas.
- Molecular clouds have a **finite lifespan**, eventually dissipating.

VOYAGER 1

SOURCE: THE HINDU

Why in News?

Voyager 1 is approaching a distance of **one light-day from Earth**, marking another milestone in deep-space exploration.

Mission Objectives

- Study **Jupiter and Saturn**, including their **moons, rings, and magnetic fields**.
- Investigate the **outer Solar System environment**.
- Extend the mission to explore **interstellar space**.

Major Instruments

- **Cosmic Ray Subsystem (CRS)** – studies high-energy particles.
- **Plasma Wave Subsystem (PWS)** – detects plasma density and waves.
- **Infrared Interferometer Spectrometer (IRIS)** – measured planetary atmospheres and temperatures.
- Magnetic field and charged particle detectors.

Key Achievements

- First spacecraft to provide **detailed images of Jupiter and Saturn**.
- Discovered **faint rings around Jupiter**.
- Detected new moons such as **Thebe and Metis** near Jupiter.
- Identified additional moons and structures in **Saturn's ring system**.
- Crossed the **heliopause** in **2012**, entering **interstellar space**.
- Continues to send back information about **cosmic radiation and plasma conditions** beyond the Sun's influence.

Scientific Importance

- Provides data on the **interstellar medium**.
- Helps understand the **boundary of the heliosphere**.
- Carries the famous **Golden Record**, representing Earth's culture and sounds.

Current Status

- Operates on limited power from **radioisotope thermoelectric generators (RTGs)**.
- Communication delay is over **20 hours one-way** due to vast distance.

WHITE DWARF

SOURCE: THE HINDU

Why in News?

Astronomers recently observed a **white dwarf** producing a **colourful bow shock** as it speeds through interstellar space. The phenomenon helps scientists study **stellar motion and interactions with surrounding gas**.

About White Dwarf

A **white dwarf** is the **dense core remnant** of a star like the Sun after it has shed its outer layers to form a **planetary nebula**. It represents one of the final stages of **stellar evolution**.

Formation Process

- Medium-sized stars exhaust their **nuclear fuel**.
- Outer layers are expelled, forming glowing gas clouds.
- The remaining hot core contracts into a **white dwarf**.

Physical Characteristics

- No longer sustains **nuclear fusion**, yet remains **extremely hot** initially.
- **Mass:** Comparable to about half the Sun's mass.
- **Size:** Similar to Earth, resulting in **extreme density**.
- Among the densest objects in the universe, after **neutron stars**.

Internal Composition

- Mainly **carbon and oxygen nuclei** with some helium.
- Surrounded by a sea of highly energetic **electrons**.
- Supported by **electron degeneracy pressure**, not normal gas pressure.
- Degeneracy pressure arises from quantum principles preventing electrons from occupying the same state.

Evolution

- Gradually **cools and dims** over billions of years.
- Eventually expected to become a **black dwarf**, though none exist yet as the universe is too young.
- If part of a binary system, accretion of matter may trigger **nova explosions**.

Scientific Importance

- Their predictable cooling helps estimate **ages of star clusters**.
- Provide insights into **stellar life cycles**.
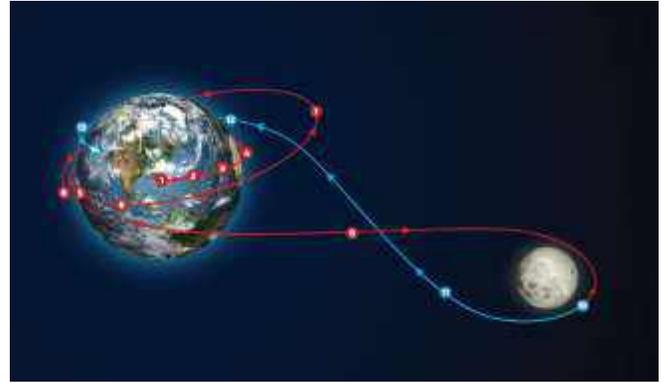- Observations of shockwaves reveal interaction between **stellar remnants and interstellar medium**.

ARTEMIS II

SOURCE: THE HINDU

Why in News?

NASA is progressing toward the **Artemis II** mission, the first crewed lunar flyby under the Artemis programme. It will mark the **first human journey beyond low Earth orbit in over 50 years**.

Mission Overview

- First crewed mission to travel near the Moon since the **Apollo era**.
- Four astronauts will undertake a **~10-day mission** around the Moon and back.
- Crew includes **three NASA astronauts** and **one from the Canadian Space Agency**.
- Objective: Validate **life support, navigation, communication, and re-entry systems**.

Spacecraft & Rocket

- **SLS rocket**: NASA's most powerful launch vehicle.
- **Orion spacecraft**: Designed for deep-space human missions.
- Orion will perform a **high-speed re-entry** before splashdown in the Pacific Ocean.

Scientific & Technical Goals

- Study **space radiation exposure** on humans.
- Test **crew health monitoring and behavioural responses**.
- Evaluate **deep-space communication systems**.
- Collect engineering data to refine future lunar missions.

Significance of Artemis Programme

- Long-term goal: Establish **sustainable human presence on the Moon**.
- Prepares for **future missions to Mars**.
- Includes the planned **Lunar Gateway** space station in Moon orbit.
- Promotes **international collaboration**.

Upcoming Artemis Missions

- **Artemis III:** Planned human landing on the Moon.
- **Artemis IV & V:** Expansion of the **Gateway station** and further lunar exploration.

Strategic Importance

- Revives human **deep-space exploration**.
- Enhances **technological innovation**.
- Strengthens international space partnerships.

GRAPHENE

Why in News?
Researchers have developed a **flexible graphene-based capacitive sensor** on a paper substrate using pencil-drawn electrodes. The innovation highlights graphene's role in **low-cost, wearable and flexible electronics**.

About Graphene
Graphene is a single layer of **carbon atoms** arranged in a **hexagonal (honeycomb) lattice**. It is one of the most remarkable materials discovered in modern science due to its exceptional **strength, conductivity, and flexibility**.

Basic Nature

- An **allotrope of carbon**, like **diamond and graphite**.
- Essentially a **two-dimensional material** only one atom thick.
- Graphite consists of **multiple stacked graphene layers**.
- First successfully isolated in **2004**, opening new avenues in nanotechnology.

Key Properties

- **Ultra-thin:** One atom thick, among the thinnest materials known.
- **High Strength:** Around **200 times stronger than steel** by weight.
- **Lightweight:** Extremely low density.
- **Flexible:** Can bend without breaking, ideal for **flexible devices**.
- **High Electrical Conductivity:** Electrons move rapidly across its surface.
- **Thermal Conductivity:** Efficient heat conductor.
- **Transparency:** Absorbs only a small fraction of visible light.
- **Impermeable:** Blocks passage of gases and liquids.

Applications

- **Electronics:** Flexible screens, transistors, and sensors.
- **Energy Storage:** Advanced batteries and supercapacitors.
- **Healthcare:** Biosensors and drug delivery research.
- **Composites:** Stronger, lighter materials for aerospace and transport.
- **Environmental Technology:** Water filtration and pollution sensors.

VERA C. RUBIN OBSERVATORY

Why in News?
Astronomers analysing early images from the **Vera C. Rubin Observatory** have identified an unusually **fast-spinning asteroid (2025 MN45)**.

Location & Administration

- Situated atop **Cerro Pachón** in the **Chilean Andes**, at high altitude with clear, dark skies.
- Jointly funded by the **U.S. National Science Foundation** and the **U.S. Department of Energy**.
- Built to carry out long-term, data-intensive sky surveys.

Core Instrument: Simonyi Survey Telescope

- **Aperture:** 8.4 metres.
- Houses the **largest digital astronomical camera ever built (3.2 gigapixels)**.
- Can capture an extremely **wide field of view** in a single exposure.
- Designed for **rapid repositioning**, enabling frequent sky coverage.
- Uses a three-mirror optical design for efficiency.

Scientific Goals

1. Study the **nature of dark matter and dark energy**.
2. Catalogue **asteroids, comets, and near-Earth objects**.
3. Map the **Milky Way's structure and history**.
4. Observe **transient phenomena** like supernovae and variable stars.

Survey Capability

- Will scan the **southern sky repeatedly for about a decade**.
- Creates a **time-lapse map of the universe**.
- Generates massive volumes of data daily, supporting global research.

Discovery of Asteroid 2025 MN45

- Located in the **main asteroid belt** between Mars and Jupiter.
- Diameter roughly **700 metres**.

- Rotates once in under **two minutes**, making it the **fastest-spinning large asteroid** identified so far.
- Helps scientists understand **asteroid structure and internal strength**.

Importance

- Enhances detection of **potentially hazardous asteroids**.
- Supports research into **cosmic evolution and galactic structure**.
- Represents a major step in **big-data astronomy**.

INDIA'S SPACE ECOSYSTEM

India's **space ecosystem is under renewed scrutiny** following recent launch setbacks and a visible decline in its share of the global small-satellite launch market. As space assets now underpin **navigation, communication, disaster response and defence**, strengthening the ecosystem has become a **strategic priority**.

Recent Developments in India's Space Sector

Human Spaceflight – Gaganyaan

- India is progressing toward its first **crewed orbital mission**, with uncrewed test flights designed to validate **life-support and crew safety systems**.
- The mission marks India's transition from robotic to **human space capability**, with implications for technology spin-offs and national prestige.

Next-Generation Launch Vehicles

- ISRO is working on **heavier-lift and future reusable-class vehicles** to enhance payload capacity and reduce launch costs.
- A dedicated small-satellite launch site in Tamil Nadu aims to support **SSLV missions and private launches**, widening industrial participation.

Commercial Expansion

- India's space economy is valued in **billions of dollars** and projected to grow sharply, driven by **satellite services, analytics, and downstream applications**.
- Reforms through **IN-SPACe** and **NewSpace India Ltd (NSIL)** have enabled private firms to build satellites, propulsion systems and launch vehicles.

Security and Surveillance Push

- Plans to expand **Earth observation and surveillance constellations** aim to improve border monitoring, maritime awareness and disaster response.
- Defence space coordination structures are gradually evolving to integrate space assets into security planning.

Private Sector Rise

- Over **300 space startups** now operate in launch systems, satellites, and geospatial analytics.
- Initiatives like **Satellite Bus as a Service** reduce entry barriers for private innovators.

Orbital Infrastructure Vision

- India has outlined plans for a **national space station** in the next decade, focusing on long-term microgravity research and strategic presence in orbit.

Regulatory and Investment Reforms

- Liberalised **FDI norms** and policy reforms aim to attract global investment and reduce funding gaps in deep-tech ventures.

Key Challenges in the Space Ecosystem

Launch Reliability Concerns

- Recent anomalies have affected perception of India's **launcher reliability**, crucial for commercial trust and strategic missions.

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Single-Site Launch Dependence

- Heavy reliance on **one major launch site** limits surge capacity and creates scheduling risks during adverse weather.

Navigation Sovereignty Issues

- India's regional navigation system requires a **full operational satellite constellation** to ensure uninterrupted coverage for civilian and defence uses.

Orbital Slot and Spectrum Competition

- Delays in international filings risk losing access to valuable **orbital positions and spectrum**, which are finite global resources.

Military Space Integration Gaps

- Defence space structures are still evolving; integration of space data into **joint military operations** remains limited.

Dependence on Foreign ISR Data

- In some cases, high-resolution imagery and intelligence data are sourced from **foreign providers**, posing risks during crises.

Space Situational Awareness (SSA) Limitations

- Tracking of small debris and hostile objects in orbit is improving but remains **less comprehensive** than leading space powers.

Supply Chain Vulnerability

- Dependence on imported **space-grade electronics and materials** exposes missions to geopolitical supply disruptions.

Policy–Execution Gap

- Although reforms exist, private firms still face **uncertain demand pipelines, funding gaps and limited assured launch access**.

Way forward

1. Restore Reliability and Mission Assurance

- Prioritise **rigorous testing, quality audits and transparent failure reviews**.
- Shift toward **fleet-level reliability engineering**.

2. Expand Launch Infrastructure

- Develop additional launch facilities to ensure **redundancy, resilience and faster turnaround**.

3. Protect Orbital and Spectrum Interests

- Fast-track international filings and treat orbital positions as **strategic assets**.

4. Strengthen Navigation System

- Ensure continuous replenishment of satellites and wider **device compatibility**.

5. Build Military Space Architecture

- Empower a **dedicated space command** and move toward **constellation-based ISR and SSA systems**.

6. Achieve Data Sovereignty

- Develop indigenous satellite imagery and communication networks to reduce **external dependence**.

7. Improve SSA and Space Security

- Expand monitoring networks and adopt **resilience-based deterrence** against counter-space threats.

8. Align Commercial and Strategic Goals

- Use **anchor procurement, export finance and insurance support** to help private firms scale.

Conclusion

India's space journey is entering a phase where **credibility, resilience and institutional coordination** matter as much as innovation. A **reliability-driven, industry-integrated and strategically aligned ecosystem** will determine India's ability to secure both economic opportunity and national security in the space age.

SECURITY

LEFT WING EXTREMISM

## SHIFT IN THE MAOIST CONFLICT LANDSCAPE

SOURCE: THE HINDU

Why in News?

Left Wing Extremism (LWE) incidents have fallen sharply, with violence now largely confined to **parts of south Bastar** in Chhattisgarh. The expansion of **security camps in remote tribal belts** is widely seen as a key factor behind the erosion of Maoist influence.

Current Status of Maoism

- **Sharp fall in violence**: Compared to the peak years around 2010, Maoist-related incidents and casualties have dropped by nearly **80–90%**, indicating a sustained decline.
- **Shrinking footprint**: The number of severely LWE-affected districts has reduced drastically over the last decade.
- **Geographical confinement**: Active insurgency is now concentrated mainly in **forest interiors of south Bastar**.
- **Leadership losses and surrenders** have weakened organisational depth and operational capacity.
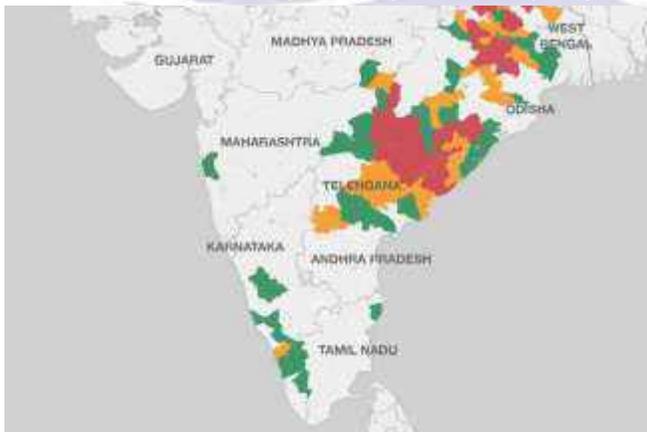
Why Maoism Expanded Earlier

- **Shift to forested Dandakaranya region** after pressure in Andhra Pradesh allowed Maoists to use dense forests and inter-state borders as shields.
- **Governance vacuum**: Remote areas lacked roads, administration, and welfare delivery.

- **Alienation of tribal communities** due to land alienation, forest restrictions, and displacement.
- **Weak implementation of Fifth Schedule protections** reduced faith in constitutional safeguards.
- **Limited local representation** in administration reinforced the perception of an outsider-controlled state.

Security Camps as a Turning Point

Permanent State Presence

- Establishment of camps in interior areas ended Maoists' ability to exercise **exclusive control**.

Improved Force Density

- Better police–population ratios reduced Maoists' freedom of movement and intimidation.

Faster Response Capability

- Quicker mobilisation during incidents curtailed ambushes and boosted troop safety.

Psychological Impact

- Visible and sustained deployment signalled that the **State is here to stay**, reducing Maoist authority among locals.

Better Intelligence Flow

- Enhanced trust with villagers improved **human intelligence**, weakening insurgent networks.

Development Following Security

- Roads, telecom towers, schools, and health services expanded after camps, linking security with **governance penetration**.

Emerging Post-Conflict Challenges

- **Shift from armed conflict to rights-based demands**: Communities now raise issues of land, forest rights, and representation.
- **Weak justice systems**: Courts, police stations, and grievance redressal remain inadequate in remote belts.
- **Fragile service delivery**: Health and education infrastructure is still thin.
- **Representation gaps**: Administration often lacks adequate local participation.
- **Risk of governance lag**: If civil administration does not deepen, security gains may not convert into lasting peace.

Way Forward

Implement Constitutional Safeguards

- Proper enforcement of **PESA** and the **Forest Rights Act** can address long-standing grievances.

Deepen Civil Administration

- Ensure regular presence of revenue, welfare, and development officials in interior villages.

Strengthen Justice Delivery

- Expand courts, legal aid, and policing to prevent revival of informal or parallel justice.

Promote Local Representation

- Recruit and empower local youth in administration and policing to build trust.

Empower Gram Sabhas

- Provide real financial and decision-making powers for grassroots self-governance.

Long-Term Peace Strategy

- A coordinated roadmap integrating **security, rights, and development** is necessary for durable stability.

Conclusion

Security camps have **structurally weakened Maoist influence** by restoring State presence in remote regions. However, lasting peace depends on **strong governance, justice delivery, and protection of tribal rights** to prevent any relapse.

TERRORISM & EXTREMISM

TERRORISM IN THE DIGITAL ERA

SOURCE: THE HINDU

Why in News?

Recent investigations into a terror incident highlighted the use of **encrypted platforms, private servers, and covert digital communication methods**. This underlines how **digital tradecraft** has become central to modern terrorist operations.

Use of Digital Tradecraft in Terrorism

Encrypted Communication

- Extremist groups use end-to-end encrypted apps that allow **anonymous sign-ups** and minimal metadata storage.
- Features like disappearing messages and hidden identities limit traceability.

Private and Self-Hosted Servers

- Some cells operate their own servers to exchange maps, manuals, and operational details.

- Such infrastructure lies outside mainstream platforms, making monitoring difficult.

Digital "Dead Drop" Methods

- Shared email accounts are used where messages are saved as drafts instead of being sent.
- This leaves **no conventional communication trail**, evading standard surveillance.

Integration with Physical Operations

- Digital planning supports reconnaissance, logistics, and timing.
- Ordinary devices and vehicles help maintain a low profile.

Multi-Layered Operational Security

- Use of VPNs, device switching, and minimal digital footprints.
- Cross-border ideological and logistical links show **global knowledge exchange**.

Impacts of Digital Tradecraft

Weakening of Traditional Surveillance

- Phone tapping and metadata analysis are less effective against encrypted and decentralised systems.
- Even banned platforms can be accessed through proxies.

Growing Transnational Dimension

- Online networks cross national boundaries, complicating jurisdiction and enforcement.
- Financing, propaganda, and training can occur remotely.

Institutional and Social Risks

- Radicalisation is no longer confined to marginal groups; **educated professionals** can be involved.
- Digital anonymity allows covert recruitment and coordination.

Way Forward

Strengthen Digital Forensic Capacity

- Create specialised units skilled in **encryption analysis, server forensics, and memory recovery**.
- Invest in advanced tools and training.

Regulate Self-Hosted Communication Systems

- Frame rules requiring lawful compliance from private servers while respecting privacy safeguards.

Cooperation with Technology Companies

- Develop frameworks for **judicially supervised lawful access** to data in terror investigations.

Update Legal Frameworks

- Modernise counter-terror laws to address encrypted communication, draft-based messaging, and decentralised networks.

Capacity Building for Investigators

- Train officers to recognise patterns of digital concealment and emerging cyber techniques.

Counter-Radicalisation in Institutions

- Universities and professional spaces should adopt awareness and intervention mechanisms.

Enhance International Cooperation

- Strengthen intelligence sharing and joint investigations, especially in cross-border digital cases.

Public Awareness

- Educate citizens on responsible digital behaviour and reporting suspicious online activity.

Conclusion

Terrorism today operates in **hidden digital layers** as much as in physical spaces. Combating this threat requires **advanced cyber-forensics, updated laws, and global cooperation** while safeguarding democratic freedoms.

EMERGING SECURITY CHALLENGES-GLOBAL COMMONS

BIOLOGICAL WEAPONS CONVENTION (BWC)

SOURCE: INDIAN EXPRESS

Why in News?

At the **50-year milestone of the Biological Weapons Convention (BWC)**, India flagged that global systems remain **underprepared for bioterrorism**, especially from **non-state actors**.

What is the Biological Weapons Convention (BWC)?

- The BWC is a global treaty banning the **development, production, stockpiling, acquisition, transfer, and use** of **biological and toxin weapons**.
- It entered into force in **1975**, becoming the first treaty to eliminate an entire category of **Weapons of Mass Destruction (WMDs)**.
- It builds on the **1925 Geneva Protocol**, which had banned only the use of such weapons.
- The treaty uses a **General Purpose Criterion**, meaning any biological agent or toxin without legitimate peaceful use is prohibited.
- Member states review the Convention every **five years** to address emerging technological risks.

India's Role

- India is an early signatory and has enacted national laws such as:
    - **Hazardous Microorganisms Rules (1989)**
    - **WMD Act, 2005**
    - **SCOMET export controls**
      These ensure compliance and control over sensitive biological materials.

Key Weaknesses in the BWC Framework

- **No verification system**: Unlike the Chemical Weapons Convention, the BWC lacks an inspection or enforcement mechanism.
- **Limited institutional capacity**: The Implementation Support Unit mainly handles coordination, not compliance checks.
- **Scientific oversight gap**: Rapid biotech progress outpaces monitoring mechanisms.
- **Low transparency**: Confidence Building Measures (CBMs) are voluntary and unevenly followed.

These gaps reduce trust and preparedness against biological threats.

Bioterrorism

- **Bioterrorism** involves the intentional release of pathogens or toxins to create illness, panic, or political pressure.
- Actors may include **terror groups or rogue individuals** rather than states.
- Examples of agents include bacteria, viruses, fungi, or toxins that target humans, animals, or crops.

Major Concerns

Mass Impact Potential

- Pathogens can spread silently, causing large-scale illness before detection.
- Public health systems can be overwhelmed quickly.

Detection Challenges

- Biological attacks resemble natural outbreaks, complicating early response and attribution.
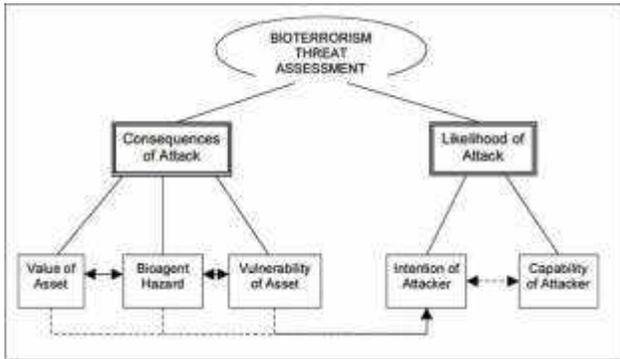
Dual-Use Technology Risks

- Research for vaccines or agriculture can be repurposed to create harmful strains.

Low Entry Barrier

- Biological weapons require less infrastructure than nuclear weapons, making them attractive to non-state actors.

Psychological and Economic Damage

- Fear and misinformation can disrupt trade, supply chains, and social stability.

Steps Needed to Strengthen Global Biosecurity

1. National Biosecurity Frameworks

- Countries should regulate high-risk labs, maintain pathogen inventories, and ensure emergency response systems.

2. Bio-Forensics and Attribution

- Develop scientific tools to trace outbreak origins, helping deter misuse and improve accountability.

3. Stronger Oversight of Dual-Use Research

- Ethical review boards, licensing, and monitoring of sensitive experiments are essential.

4. Support to Vulnerable Nations

- Many developing countries lack surveillance systems.
- Equitable access to **vaccines, diagnostics, and technology** is vital.

5. Article VII Assistance Mechanism

- Establish a global database and coordination system for rapid help in case of biological incidents.

6. Improved Transparency

- Regular reporting of facilities, legislation, and disease outbreaks can build confidence among nations.

7. International Cooperation

- Biosecurity requires coordination among health, environment, agriculture, and security agencies.
- Agreements on biosafety and responsible research can reinforce global resilience.

India's Perspective

India advocates:

- A **legally binding verification mechanism** under the BWC.
- Inclusion of **Global South countries** in biosecurity planning.
- Balancing innovation with **ethical safeguards**.
- Greater cooperation in disease surveillance and capacity building.

Conclusion

Biological risks are rising due to scientific advances and the threat from non-state actors, while the **BWC still lacks strong enforcement tools**. Strengthening verification, oversight, and global cooperation—especially for vulnerable nations—is essential to build a **secure and resilient biosecurity system**.

PRELIMS POINTERS IN NEWS

INS SUDARSHINI

SOURCE: PIB

Why in News?

The Indian Navy's sail training vessel **INS Sudarshini** is set to undertake **Lokayan-26**, a long-duration international voyage covering multiple continents.

About INS Sudarshini

- **Type:** Sail Training Ship (STS).
- **Built by: Goa Shipyard Limited**, an indigenous defence shipbuilder.
- **Commissioned: 27 January 2012**.
- **Base:** Operates under the **Southern Naval Command** at Kochi.
- Symbolises India's commitment to preserving **classical navigation and sailing traditions**.

Key Features

- A **three-masted barque**, combining traditional sail design with modern naval equipment.
- Can operate using both **sails and auxiliary engines**.
- Designed for **long-endurance voyages**, capable of remaining at sea for extended periods without frequent resupply.
- Equipped to train cadets in **navigation, meteorology, ship handling, and survival skills**.

Training Importance

- Enhances **physical endurance, teamwork, and leadership** among naval trainees.
- Teaches sailors to read **winds, tides, and weather**, strengthening practical sea sense.

- Promotes **self-reliance and discipline**, core to naval culture.

Lokayan-26 Expedition

- A **10-month transoceanic voyage** covering over **22,000 nautical miles**.
- Scheduled to visit **18 ports in 13 countries** across different regions.
- Participation in global tall-ship gatherings such as **Escale à Sète (France)** and **SAIL 250 (USA)**.
- Includes trainees from the **Indian Navy and Indian Coast Guard**.

RBS-15 MISSILE

SOURCE: THE HINDU

Why in News?
Swedish defence major **Saab** recently demonstrated the advanced strike capability of the **RBS-15 missile**, highlighting its ability to target sophisticated air-defence components.

Development & Role

- Originated in **Sweden** as a maritime strike missile.
- Designed to counter **surface warships and high-value land targets**.
- Used by several European and international armed forces.
- Emphasises **precision strike** in contested electronic warfare environments.

Technical Features

- **Length:** ~4.3 m; **Wingspan:** ~1.4 m.
- **Launch weight:** ~800 kg (approx.).
- **Speed:** High subsonic (around **Mach 0.9**).
- **Range:** Modern variants exceed **200 km**, with newer versions offering greater reach.
- **Warhead:** Around **200 kg high-explosive, pre-fragmented** type.

Guidance & Navigation

- Combines **Inertial Navigation System (INS)** and **satellite navigation (GPS/GNSS)**.

- Equipped with a **radar altimeter** for low-altitude flight.
- Terminal phase uses an advanced **active radar seeker** for target locking.
- Features **mission planning software** for complex attack routes.

Operational Strengths

- **Sea-skimming flight** profile reduces detection probability.
- Executes **evasive manoeuvres** to defeat air defence systems.
- Designed with **low radar and infrared signature**.
- Highly resistant to **electronic countermeasures (ECM)** like jamming and decoys.
- Capable of engaging **moving maritime and fixed land targets**.

Strategic Significance

- Enhances **naval strike capabilities** in littoral and open-sea environments.
- Supports **area denial strategies** and coastal defence.
- Reflects growing focus on **multi-role precision missile systems** in modern warfare.

BHAIRAV BATTALIONS

SOURCE: THE HINDU

Why in News?
A newly raised **Bhairav Battalion** of the **Indian Army** is set to participate in the **Republic Day parade** on Kartavya Path for the first time.

Composition & Structure

- Each battalion consists of around **250 personnel**.
- Personnel drawn from multiple arms: **infantry, artillery, air defence, signals**, and support services.
- Designed as **self-sufficient units** with integrated capabilities.

Operational Role

- Specialised for **swift, surprise, and high-impact missions**.
- Positioned **closer to border areas** for rapid deployment.
- Meant to tackle **immediate tactical challenges** rather than long-planned strategic operations.
- Concept built around readiness to **"fight tonight"** — rapid mobilisation without delay.

Difference from Special Forces

- **Para Special Forces** undertake deep strategic missions.
- **Bhairav units** focus on **short-notice tactical responses**.
- Act as an **intermediate force** between elite commandos and regular infantry.
- Frees Special Forces to focus on **higher-priority strategic roles**.

Deployment Areas

- Being stationed in **sensitive sectors** such as:
  - Rajasthan
  - Jammu region
  - Ladakh
  - Northeastern states

Technology & Capabilities

- Equipped for **multi-domain warfare**.
- Includes **drone operations, electronic support systems, and modern communication tools**.
- Emphasis on **mobility, coordination, and quick decision-making**.

Strategic Significance

- Enhances **border readiness**.
- Supports India's move toward **integrated and flexible force structures**.
- Reflects adaptation to **modern, technology-driven warfare**.

SOCIETY

VULNERABLE SECTIONS OF SOCIETY

INVALIDATION ALL FORMS OF UNILATERAL TALAQ

SOURCE: THE HINDU

Why in News?

Courts have recently examined the legality of certain **forms of unilateral talaq**, questioning whether divorce without mutual process violates **women's rights and constitutional equality**.

Nature of Marriage in Islam

Marriage as a Contract

- Islamic jurisprudence views marriage as a **civil contract (nikah)** between two consenting adults.
- It is not a sacrament placing one spouse above the other.

Concept of Mutuality

- Quranic terms describing marriage indicate a **solemn covenant** based on consent and shared responsibility.
- This framework discourages any **one-sided authority**.

Principle of Natural Justice

- A person cannot be the sole decision-maker in a dispute that affects both parties.
- Hence, unilateral dissolution contradicts **basic fairness norms**.

Quranic Framework of Divorce

Divorce as a Last Resort

- Divorce is permitted but discouraged; reconciliation is prioritised.

Stages Before Divorce

- Dialogue and counselling between spouses.
- Temporary separation to ease tensions.
- Involvement of mediators from both families.

Phased Nature of Talaq

- Pronouncements are spaced over time, allowing room for reconciliation.
- The **iddah period** serves as a reflection phase.

Transparency and Witnessing

- Final separation must be open, fair, and not impulsive.

Extra-Quranic Talaq Practices

Later Juristic Practices

- Forms like **instant triple talaq** and other unilateral methods developed through later interpretations, not directly from Quranic text.

Gender Imbalance

- Such practices often grant men sole power, limiting women's agency.

Social Consequences

- Sudden divorce can lead to **economic insecurity, social stigma, and psychological harm** for women.

Constitutional and Legal Dimensions

Equality Before Law

- Article 14 ensures protection against arbitrary action.
- Unilateral divorce powers can violate this principle.

Right to Dignity

- Article 21 protects personal dignity; abrupt marital termination undermines it.

Judicial Intervention

- In 2017, the Supreme Court declared **instant triple talaq unconstitutional**, terming it arbitrary.

Legislative Response

- The **Muslim Women (Protection of Rights on Marriage) Act, 2019** made instant triple talaq void and punishable.
- It provides **maintenance rights and child custody provisions**.

Harmony Between Faith and Constitution

- The Quranic approach emphasises fairness and reconciliation, which aligns with constitutional morality.

Way Forward

- Promote awareness of the **Quranic due process model** of divorce.
- Strengthen mediation and counselling mechanisms.
- Ensure legal literacy among women about rights and remedies.
- Encourage reforms within personal law that uphold **gender-neutral justice**.

Conclusion

Marriage in Islam is based on **consent, dignity, and shared responsibility**. Ensuring that divorce follows a **fair, phased,**

and gender-just process upholds both religious principles and constitutional equality.

HEALTH SECTOR

STATUS OF HEALTHCARE IN INDIA

SOURCE: THE HINDU

Why in News?

Debate is growing over the expansion of **Public–Private Partnerships (PPPs)** in district hospitals and medical education, with concerns that long-term concessions may weaken **public control** over core health services.

What the Healthcare PPP Model Proposes

- Private partners **build and run medical colleges** on public land under long leases.
- **District hospitals handed to private operators** for extended periods.
- Government provides **viability gap funding and grants** for upgrading facilities.
- Private entity retains **operational control** while delivering a mix of paid and government-supported services.

Current Status of Healthcare in India

System Structure

- **Three-tier public system**:
  Primary care (sub-centres, PHCs, HWCs) →
  Secondary care (CHCs, district hospitals) →
  Tertiary care (medical colleges, apex hospitals).
- **Private sector dominance** in diagnostics, specialised surgery, and urban hospital care.

Key Data Trends

- **Government share of health spending** has nearly doubled in a decade, reducing **out-of-pocket expenditure (OOPE)**, though it remains high compared to global averages.
- **Doctor–population ratio** appears adequate nationally but hides severe **rural shortages**.
- Major workforce gaps remain in **specialists, nurses, and paramedics**.
- **Bed availability** is uneven, with urban concentration and district-level deficits.
- PPPs already operate in **dialysis, diagnostics, ambulance services, and insurance-linked hospital care**.

Arguments Supporting PPP in Healthcare

1. Rapid Capacity Creation

- PPPs enable faster construction of hospitals, colleges, and diagnostic units compared to traditional public works.

2. Resource Augmentation

- Mobilises private capital in a sector with limited public budgets.

3. Managerial Efficiency

- Private management may reduce project delays and improve maintenance.

4. Technology Infusion

- Facilitates access to advanced imaging, IT systems, and specialised equipment.

5. Human Resource Support

- Flexible hiring helps address faculty and specialist shortages.

6. Risk Sharing

- Construction and operational risks partly transferred away from government.

7. Service Standardisation

- Contracts can link payment to performance and service quality indicators.

Concerns and Limitations of the PPP Route

1. Dilution of Public Ownership

- Long leases of district hospitals and land resemble **de facto privatisation** of core public assets.

2. Profit vs Public Welfare

- Private incentives may prioritise **high-revenue procedures** over preventive or essential care.

3. Risk of Reduced Access

- "Free" beds may shrink, while paid services expand, increasing household burden.

4. Fragmentation of Care

- District hospitals serve as referral hubs; commercial management may weaken **system integration**.

5. Weak Regulatory Capacity

- Many states lack the expertise to enforce complex contracts or monitor compliance effectively.

6. Skewed Service Mix

- PPP facilities may favour diagnostics and tertiary services over **primary and preventive care**.

7. Workforce Commercialisation

- Medical education under PPP may raise fees, reducing accessibility for rural and low-income students.

Why Public System Strengthening May Be Preferable

1. Primary Care First

- Strong first-contact care can prevent a large share of avoidable hospitalisations.

2. Retaining District Hospitals as Public Anchors

- Essential for equitable referral chains and emergency response.

3. Public Investment in Medical Education

- Subsidised training tied to rural service can correct workforce imbalance.

4. Direct Recruitment & Incentives

- Public service bonds and rural incentives can fill specialist gaps sustainably.

5. Limited, Targeted PPP Use

- PPPs may be suitable for **support services** (labs, maintenance) rather than full hospital control.

6. Stronger Regulation Before Expansion

- Contract enforcement, pricing oversight, and quality audits must precede large-scale PPP rollout.

Way Forward

- Increase **public health spending** steadily to global middle-income norms.
- Strengthen **primary healthcare networks** under Health & Wellness Centres.
- Upgrade district hospitals through **public funding** and specialist deployment.
- Reform medical education with **public seats, scholarships, and faculty investment**.
- Use PPPs selectively, transparently, and for **non-core, time-bound services**.
- Improve **state capacity in regulation, monitoring, and health governance**.

Conclusion

Healthcare expansion must prioritise **equity, continuity, and public accountability** over speed alone. While PPPs can supplement specific services, a **robust, publicly funded health system** remains the most reliable foundation for **universal, affordable, and integrated care**.

PRELIMS POINTERS IN NEWS

LAMBADI TRIBE

SOURCE: INDIAN EXPRESS

Why in News?

The **Supreme Court** is examining disputes related to the **Scheduled Tribe (ST) status** of the **Lambadi (Banjara/Sugali)** community in Telangana.

The issue concerns the **constitutional authority of Parliament** and the criteria for tribal classification.

Geographical Distribution

- Concentrated in **Telangana, Andhra Pradesh, and Karnataka**.
- Smaller populations are also found in **Maharashtra, Madhya Pradesh, and Rajasthan** under the broader Banjara identity.
- Traditionally lived in **"thandas"** (settlement clusters), often located on village outskirts.

Ethnic and Linguistic Identity

- Speak **Gor Boli (Lambadi language)**, an **Indo-Aryan** language despite their southern location.
- Language has **no formal script** and survives mainly through oral tradition.
- Linguistic traits reflect their historical role as **traders and transporters** across regions.

Social and Religious Practices

- Majority follow **Hindu traditions**, while retaining **animistic beliefs** linked to nature worship and ancestral spirits.
- Community elders and traditional councils play a role in dispute resolution.
- Strong group identity preserved through **endogamy and clan systems**.

Cultural Features

- **Traditional attire** is highly distinctive: Lambadi women wear bright embroidered garments decorated with **mirrors, shells, and coins**, along with heavy ornaments and ivory bangles.
- **Tattooing** is culturally significant and often linked to identity and marital status.
- Popular dance forms include **fire dance** and **Chari dance**, performed during festivals.
- Celebrate **Teej festival** in Shravan month, where unmarried girls pray for a good life partner.

Livelihood Patterns

- Historically **nomadic traders and cattle herders**.
- Over time shifted to **agriculture, daily wage labour, and handicrafts**.
- Many continue to face **poverty, low literacy, and landlessness**.

BAGURUMBA DANCE (BODO FOLK DANCE)

Why in News?

The **Prime Minister of India** recently witnessed a massive performance of the **Bagurumba dance** in Assam, featuring participation of over **10,000 artistes**.

Cultural Context

- Closely linked to **Bwisagu**, the **Bodo New Year festival**, celebrated in April.
- Also associated with **Domasi** and other traditional celebrations.
- Considered a symbol of **ethnic identity** of the Bodo people.

Themes & Symbolism

- Inspired by the **natural world**—flowers, butterflies, birds, and leaves.
- Movements reflect **growth, renewal, and ecological balance**.
- Represents the **joy of community life** and unity.

Dance Features

- Characterised by **soft, rhythmic, and flowing movements**.
- Dancers often perform in **circular or linear formations**, creating visual symmetry.
- Traditionally performed by **women**, while **men play musical instruments**.
- Gestures imitate **fluttering wings and swaying plants**, showing nature's rhythm.

Costume & Ornaments

- Dancers wear colourful, handwoven **dokhna** (traditional attire), along with **jwmgra** (scarf) and **aronai** (decorative cloth).
- Colours like **red, yellow, and green** dominate, symbolising vitality and nature.
- Traditional jewellery enhances the aesthetic appeal.

Musical Instruments

- **Kham** – a long drum made of wood and animal skin.
- **Sifung** – a bamboo flute producing melodious tunes.
- Other instruments include **Jota, Gongwna, and Tharkha**, creating rhythmic accompaniment.

Significance

- Preserves **oral traditions and indigenous art forms**.
- Strengthens **community bonding** and cultural pride.
- Promotes **Northeast India's cultural visibility** at the national level.

HATTI TRIBE

Why in News?

The **Boda Tyohar**, the largest annual festival of the **Hatti tribe**, has begun in Himachal Pradesh with large community participation. The festival showcases the **cultural identity and traditions** of this tribal group.

About Hatti tribe

The **Hatti tribe** is a traditional community residing along the **Himachal Pradesh–Uttarakhand border**. The name "Hatti" originates from their historical practice of trading agricultural produce in local markets known as **"haats."**

Geographical Distribution

- Inhabit the **Trans-Giri region** of **Sirmaur district (Himachal Pradesh)**.
- Also found in **Jaunsar-Bawar** region of **Uttarakhand**.
- Settlements lie in the basins of the **Giri and Tons rivers**, tributaries of the Yamuna.

Tribe	Region
Toda	Nilgiri Hills, Tamil Nadu
Khasa	Uttarakhand (especially Jaunsar Bawar region)
Hatti	Himachal Pradesh (Sirmaur, Trans-Giri region)
Khasi	Meghalaya
Ladani Bota	Northern India (exact locality not well defin
Nayar	Kerala (historically, in matrilineal setup)

Social Structure & Traditions

- Society is organised under a traditional council called **"Khumbli"**, which settles disputes and community issues.
- Distinctive **white headgear** worn by men during ceremonies.
- Cultural ties exist between Himachal and Uttarakhand Hattis; **intermarriage is common**.

Marriage Practices

- Practise **"Jodidara"**, a form of **polyandry** where a woman may marry brothers of a family.
- This custom has historical recognition under certain regional laws.

Economic Life

- Primarily dependent on **agriculture**.
- Grow **cash crops** suitable to the hill climate.
- Traditional livelihood patterns linked to **local trade networks**.

Population & Legal Status

- Community population is estimated in lakhs.
- Granted **Scheduled Tribe (ST) status** in Himachal Pradesh in **2023**.
- Jaunsar-Bawar region of Uttarakhand has long had **tribal recognition**.

Boda Tyohar (Magho Festival)

- Biggest annual cultural event of the Hatti community.
- Celebrated with **rituals, music, dance, and community gatherings**.
- Reinforces **social bonds and cultural continuity**.

KATHPUTLI

SOURCE: THE HINDU

Why in News?

In **Jaipur**, nearly **250 families** continue to preserve the traditional art of **Kathputli** puppetry.

About Kathputli

Kathputli is a historic **string puppet theatre** form from **Rajasthan**, deeply rooted in oral storytelling and folk culture. The word combines **"kath" (wood)** and **"putli" (doll)**, reflecting its handcrafted wooden puppets.

Origin & Materials

- Puppets made using **wood, cloth, cotton, and thread**.
- Upper body carved from wood; lower body draped in **flowing skirts**.

- Puppets **do not have legs**, enhancing fluid movement.
- Controlled using **two to five strings** attached to the puppeteer's fingers.

Distinctive Features

- Large painted eyes, **arched eyebrows**, and sharp expressions.
- Costumes inspired by **royal attire and desert culture**.
- Exaggerated features help convey **drama and emotion**.

Themes & Storytelling

- Traditionally narrates tales of **Rajput rulers, warriors, and folk heroes**.
- Includes **moral stories, legends, and episodes from daily life**.
- Performances blend **humour, satire, and music** to engage audiences.

Performance Elements

- Accompanied by **folk music**, especially **dholak** and **harmonium**.
- Puppeteers often provide **live narration and dialogue**.
- Shows are lively and interactive, performed in **village squares and fairs**.

Cultural Significance

- Preserves **oral traditions and local history**.
- Acts as a medium of **social commentary**.
- Symbol of Rajasthan's **folk identity and craftsmanship**.

Current Challenges

- Declining traditional patronage.
- Competition from modern entertainment.
- Need for **cultural tourism support and institutional backing**.

REFORMS IN INDIAN EDUCATION SYSTEM

India's education system is witnessing a growing shift toward **privatisation and coaching dependence**, raising concerns that education is becoming a **market commodity** instead of a **constitutional right**.

At the same time, **NEP 2020 reforms** aim to make education inclusive, multidisciplinary, and skill-oriented, exposing the gap between policy ambition and ground-level quality.

Major Hits of NEP 2020 in the Indian Education Sector

Major Reforms Transforming Indian Education

1. Right to Education (RTE) Act, 2009

- Legal guarantee of **free and compulsory education** for ages 6–14.
- Improved enrolment and gender parity at primary level.
- Introduced norms for pupil–teacher ratio, infrastructure, and no-detention policy.

2. National Education Policy (NEP) 2020

- Structural change via **5+3+3+4 curriculum**.
- Focus on **early childhood education**, mother tongue instruction, and experiential learning.
- **Higher Education Reforms:**
    - **Academic Bank of Credits**
    - Multiple entry/exit options
    - Multidisciplinary universities
    - GER target: **50% by 2035**

3. Samagra Shiksha

- Umbrella scheme integrating SSA, RMSA, Teacher Education.
- Focus on **infrastructure, teacher training, inclusion, and digital classrooms**.

4. Foundational Learning Push

- **NIPUN Bharat Mission** ensures literacy and numeracy by Grade 3.

5. Digital Education Expansion

- **DIKSHA**, **SWAYAM**, **PM eVIDYA**, and TV/radio channels reduce learning disruption.

6. Social Inclusion

- KGBVs, Eklavya Schools, minority & SC/ST scholarships improve access for marginalised groups.

Key Structural Problems

1. Low Public Spending

- Education expenditure remains around **3–3.5% of GDP** vs **6% NEP target**.
- Underfunding affects teacher hiring, labs, hostels, and digital tools.

2. Infrastructure Gaps

- Many schools lack **electricity, safe buildings, toilets, labs, libraries**.
- Poor infrastructure lowers attendance, especially for girls.

3. Teacher Shortage and Quality Issues

- Large vacancies in rural schools.
- Single-teacher schools affect learning outcomes.

4. Digital Divide

- Rural and government schools lack devices, connectivity, and smart classrooms.
- Reinforces inequality in access to future skills.

5. Commodification of Education

- Families rely on **private schools and coaching**, increasing financial burden.
- Education increasingly linked to income level → **inequality in opportunity**.

6. Research & Innovation Deficit

- R&D spending ~**0.7% GDP**.
- Universities lack global research competitiveness.

7. Dropout Funnel at Secondary Level

- Weak foundational learning leads to failure in Class 9–10.
- Socio-economic pressures push adolescents into labour.

Measures Needed

1. Increase Education Spending

- Gradually reach **6% GDP**.
- Focus on rural infrastructure and teacher recruitment.

2. Revitalise Government Schools

- Upgrade facilities and learning outcomes to regain public trust.

3. Teacher Reform

- Regular recruitment + continuous training (NISHTHA, DIKSHA).
- Incentives for rural postings.

4. Reduce Private Fee Burden

- Transparent fee regulation and financial disclosure.

5. Strengthen Higher Education

- Expand public universities in low GER states.
- Improve hostels, scholarships, digital access.

6. Research Ecosystem Boost

- Funding for PhDs, innovation clusters, industry collaboration.

7. Prevent Dropouts

- Scholarships, residential schools, mid-day meals, transport support.

8. Shift to Competency-Based Learning

- Implement **NCF 2023**, experiential pedagogy, open-book exams.

9. Vocational Integration

- Skill courses from middle school.
- Industry-school linkages.

10. Bridge Digital Gap

- Internet connectivity, devices, teacher digital literacy.

Conclusion

India's challenge is not access alone but **quality, equity, and affordability**. If education remains a **public investment rather than a private commodity**, India can convert its demographic advantage into **sustained economic and social progress**.

SAMMAKKA–SARALAMMA JATARA (MEDARAM JATARA)

Telangana is preparing for the **biennial Sammakka–Saralamma Jatara**, one of the **largest tribal congregations in the world**. The event highlights **indigenous faith traditions, forest culture, and community identity**.

Historical Background

- The festival commemorates a **legendary tribal uprising** believed to have occurred in the **12th–13th century**.
- According to oral history, **Sammakka**, a tribal woman, and her daughter **Saralamma** resisted unjust taxation imposed on forest dwellers during a severe drought.
- Their sacrifice turned them into **deified figures**, worshipped as protectors of tribal autonomy.
- The narrative represents the struggle of **forest communities against exploitation**, blending history with myth.

Location

- Celebrated in **Medaram**, inside the **Eturnagaram Wildlife Sanctuary**, part of the **Dandakaranya forest belt**.
- The remote forest setting reinforces the festival's link with **nature and tribal cosmology**.
- Unlike permanent temples, the deities are represented by **sacred bamboo structures** brought ceremonially from the forest.

Deities & Belief System

- **Sammakka**: The mother goddess symbolising **valor and justice**.
- **Saralamma (Saralakka)**: Her daughter, representing **sacrifice and devotion**.
- Other associated deities include **Pagididda Raju** and **Govindaraju**.

- Worship is **non-Brahmanical**; rituals are conducted by **Koya tribal priests** following traditional customs.

Rituals & Ceremonial Practices

1. Arrival of the Deities

- Priests bring the deities from the forest in a **ritual procession**, marking the start of the Jatara.

2. Offerings (Bangaram)

- Devotees offer **jaggery (called bangaram, meaning gold)** equivalent to their body weight.
- Symbolises gratitude and faith.

3. Sacred Bath

- Pilgrims take a ritual bath in **Jampanna Vagu**, a stream linked with the legend of Sammakka's son Jampanna.

4. Community Participation

- Millions gather, cutting across caste, religion, and region.
- Rituals emphasize **collective worship rather than individual priesthood**.

Unique Features

- Considered one of the **largest tribal festivals globally**, with attendance in millions.
- Reflects **animism and nature reverence**.
- No idol worship; instead **symbolic wooden/bamboo representations**.
- A blend of **spirituality, fair, and social gathering**.

Socio-Cultural Significance

- Strengthens **tribal identity and solidarity**.
- Acts as a platform for **cultural exchange and preservation of folklore**.
- Encourages inter-community harmony.
- Provides livelihood opportunities through **local trade and crafts**.

Economic & Administrative Aspects

- Temporary infrastructure like roads, sanitation, and health camps is set up.
- Generates income for local communities.
- Requires large-scale coordination for **crowd management and environmental protection**.

Environmental Dimension

- Conducted in a **forest zone**, raising concerns about waste and ecological pressure.
- Authorities promote **eco-friendly practices** to protect the sanctuary.

Challenges

- **Environmental Stress:** Large gatherings inside forest areas cause **deforestation, waste accumulation, water pollution, and wildlife disturbance**.
- **Public Health Risks:** Mass congregation increases chances of **disease outbreaks, unsafe food consumption, and heat-related illnesses**.
- **Infrastructure Limitations:** Remote forest location leads to **inadequate roads, sanitation, electricity, and water facilities**.
- **Crowd Management:** High pilgrim density creates risks of **stampedes, missing persons, and communication breakdowns**.
- **Cultural Dilution:** Commercialisation and external influence threaten the **authentic tribal character and traditional practices**.
- **Administrative Strain:** Multiple departments face difficulty in **coordinating logistics, security, and essential services**.
- **Security Concerns:** Huge crowds create opportunities for **theft, trafficking, and law-and-order issues**.

Way Forward

- **Eco-Sensitive Planning:** Adopt **plastic bans, waste management, and eco-friendly infrastructure** to reduce environmental damage.
- **Scientific Crowd Management:** Use **technology, surveillance, and staggered entry systems** to regulate pilgrim flow.
- **Strengthening Public Health Systems:** Deploy **mobile hospitals, safe drinking water systems, and food inspections**.
- **Infrastructure Upgradation:** Develop **permanent, sustainable facilities** that minimise repeated ecological disturbance.
- **Tribal-Centric Governance:** Ensure **Koya tribal participation** in decision-making to protect cultural integrity.
- **Disaster Preparedness:** Create **emergency response systems, drills, and evacuation plans** for crisis situations.
- **Digital Documentation:** Record rituals to preserve **intangible tribal heritage** for future generations.
- **Sustainable Tourism Model:** Promote **regulated, eco-friendly tourism** instead of uncontrolled commercialization.

Conclusion

The **Sammakka–Saralamma Jatara** represents the **spiritual, cultural, and historical ethos of tribal India**. It stands as a powerful reminder of **community resilience, nature worship, and indigenous heritage**.

ANDHRA PRADESH AS A GLOBAL GREEN HUB

Andhra Pradesh is rapidly emerging as a national hub for **large-scale green hydrogen and green ammonia projects**, with several multi-billion-dollar proposals and foundation-stone events announced since 2024.

Major Projects

- **Visakhapatnam Green Hydrogen Hub (Pudimadaka / Visakhapatnam area)** — a flagship, large-scale green hydrogen hub announced with multi-GW renewable capacity and integrated infrastructure (electrolysers, desalination, storage, chemical zone and port access). This hub is being promoted as a major export and domestic supply centre for green chemicals and fuels.

- **Kakinada / East Godavari green ammonia complex** — a USD ~10-billion scale, export-oriented green ammonia project near the port of Kakinada with planned annual production in the order of 1.5 million tonnes (announced phases and equipment milestones), aimed primarily at overseas markets.

- **Large private and JV projects** — several MoUs and investment commitments: UK firm Yamna, Evren/Axis (Brookfield JV), Select Energy/ Juno Joule and other international developers have signed MoUs or LOIs to build green hydrogen/ammonia capacity and the required renewables stack in Andhra Pradesh. These deals include commitments for GW-scale renewables, storage and 0.25–1.0 Mtpa (million tonnes per annum) green hydrogen/ammonia outputs.

Why Andhra Pradesh?

- **Coastal location & port access** — proximity to deep-water ports (Visakhapatnam, Kakinada, Krishnapatnam) reduces export logistics cost for ammonia and derivatives.

- **Large land availability** — expansive coastal tracts suitable for solar + wind parks and dedicated hydrogen hubs.

- **Grid & transmission planning** — hub development integrates 7–20 GW renewable allocation with dedicated substation corridors and potential captive transmission lines.

- **Policy & state support** — Andhra Pradesh's industrial and renewable policies (fast-track approvals, land allotment, single-window clearances) have attracted developer interest.

- **Desalination & water strategy** — coastal projects plan integrated desalination (sea water → fresh water) to meet electrolysis feedstock without stressing inland freshwater.

Technology & Process

- **Electrolysis technologies**: Proton Exchange Membrane (PEM), Alkaline and emerging Solid Oxide Electrolysers (SOE) — choice affects CAPEX/OPEX, electricity profile and part-load flexibility.

- **Renewable input**: Grid-connected or dedicated solar/wind farms; hybrid and storage solutions to maximise electrolyser capacity factor and lower Levelised Cost of Hydrogen (LCOH).

- **Desalination**: Seawater reverse osmosis (SWRO) integrated to produce MilliQ-grade water for electrolysers with zero/low discharge systems.

- **Ammonia synthesis**: Haber-Bosch process adapted with green H_2; some projects explore modular or low-temperature synthesis alternatives to improve flexibility.

- **Derivatives & export**: Green ammonia, methanol (via synthesis with CO_2), and LOHC (liquid organic hydrogen carriers) as exportable, easier-to-store carriers.

Scale, Economics & Targets

- Announced investments in AP range from **₹10,000 crore** (mid-sized plants) to **$10 billion / ₹84,000+ crore** mega-projects, with capacity claims from **hundreds of kilotonnes to >1 Mtpa** of green ammonia and multi-GW renewable commitments. These projects aim to produce green hydrogen at scale for domestic decarbonisation and exports to demand centres in Europe and East Asia.

- **Job & value creation**: Proponents estimate thousands of direct & indirect jobs plus significant manufacturing and port activity; downstream benefits include fertiliser blending, shipping bunkering and industrial feedstocks.

Infrastructure & Ecosystem Requirements

- **Dedicated renewables capacity** (multi-GW) with priority grid access and wheeling arrangements.

- **Large-scale electrolysers** (modular plants for scaling), hydrogen storage (salt caverns not widely available on coastlines — so above-ground storage and ammonia conversion are favoured).

- **Water treatment and zero liquid discharge**: desalination plants sized for electrolyser feedstock.
- **Chemical zone & ports**: storage tanks, bunkering facilities and NH_3 export terminals; pipelines for product transfer to ships or local users.
- **Skilled workforce & manufacturing**: electrolyser fabrication, balance-of-plant and O&M capacities.

Environmental, Social & Resource Considerations

- **Water use**: Electrolysis demands significant ultrapure water; coastal desalination is planned but needs careful planning to avoid marine impacts.
- **Land and ecological footprint**: Large arrays of solar/wind must avoid high-value agricultural land and sensitive habitats; environmental clearances must be rigorous.
- **Local livelihoods**: Projects can create jobs but must include reskilling programmes, local hiring quotas and community benefit schemes.
- **GHG accounting**: Full lifecycle analysis (grid vs dedicated RE) crucial — green hydrogen only low-carbon if electricity is renewable and additional.

Challenges & Risks

1. **LCOH & commercial viability** — electrolyser and CAPEX costs remain high though falling; project economics depend on low-cost renewables, electrolyser capacity factors and policy support.
2. **Grid integration & curtailment** — very large renewable stacks require transmission upgrades and storage to ensure electrolyser utilisation.
3. **Water & environmental permits** — obtaining clearances for desalination, effluent treatment and coastal construction can delay projects.
4. **Export market uncertainty & certification** — long-term offtake contracts and green-fuel certification (EU/Japan standards) are critical to investor confidence.
5. **Supply chain & localisation** — domestic manufacturing of electrolysers, catalysts and balance-of-plant is nascent; import dependence raises costs and strategic risk.
6. **Financing & project execution risk** — mega projects need long tenors and patient capital; construction and commissioning risks are sizable.

Recommendations & Way Forward

1. **Integrated hub planning**: co-locate renewables, electrolysers, desalination and port facilities with a single master plan to minimise transmission losses and streamline approvals.
2. **Financial de-risking**: blended finance (sovereign, multilateral, concessional) for electrolyser CAPEX,

plus viability gap funding or revenue-support mechanisms to bridge initial LCOH.
3. **Local manufacturing push**: incentivise electrolyser, catalyst and balance-of-plant manufacturing through PLI-style schemes to reduce import dependence.
4. **Water stewardship**: mandate seawater desalination with stringent marine impact mitigation and reuse of process water.
5. **Certification & offtake**: negotiate long-term green-ammonia purchase agreements with importers and align lifecycle accounting to RFNBO/market standards.
6. **Social inclusion**: mandatory local hiring, skilling programmes and community benefit funds to ensure equitable development.
7. **Grid & storage planning**: invest in grid reinforcements and large-scale storage (batteries, pumped hydro) to support high electrolyser utilisation.
8. **Export ecosystem**: develop ammonia bunkering standards, cold-chain logistics and port customs facilitation to reduce time-to-market.

Conclusion

Andhra Pradesh is emerging as a **major hub for green hydrogen and green ammonia, s**upported by coastal advantages, ports, and renewable energy potential. These projects can **boost clean energy exports, industrial decarbonisation, and local employment, strengthening India's energy transition go**als. Sustainable water use, environmental safeguards, and strong policy support will be crucial for long-term success.

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