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MAGAZINE

June 2025

Index

History and Art & Culture

Prelims

Kerala's Tribal Handicraft Secures GI Tag

Sub Topic: *Indian culture covering the salient aspects of Art Forms, literature and Architecture from ancient to modern times.*

Context:

Kannadippaya, a distinctive tribal handicraft from Kerala, has been awarded the prestigious Geographical Indication (GI) tag—marking a **significant milestone in preserving traditional knowledge and empowering tribal artisans.**

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- This recognition **not only offers market protection but also provides a global platform for promoting this centuries-old craft.**
- The GI tag has been granted to **two cooperative groups from Idukki district:** the **Unarvu Pattikavargha Vividodesha Sahakarana Sangam in Venmani, and the Vanasree Bamboo Craft & Vanavibhava Shekarana unit in Moolakkad, Uppukunnu.**
- With this honour, **Kannadippaya becomes the first tribal handicraft from Kerala to receive GI recognition.**

A Craft Rooted in Tradition

- The name **"Kannadippaya"** translates to **"mirror mat,"** referring to its characteristic reflective weave pattern.
- **These mats are traditionally crafted using the soft inner layers of reed bamboo**, known for their functional properties—**providing warmth during cold weather and a cooling effect in summer.**
- The craft is **nurtured by several tribal communities,** including the **Oorali, Mannan, Muthuva, Malayan, and Kadar,** along with artisans from the Ulladan, Malayarayan, and Hill Pulaya groups.
  - These communities are spread across the districts of Idukki, Thrissur, Ernakulam, and Palakkad.
- The finest Kannadippaya mats are made using Teinostachyum wightii, locally called **Njoonjileetta, Njoojoora, Ponneetta, Meieeta, and Neytheetta.**
- Other bamboo varieties like **Ochlandra species**—referred to as Kareetta, Pereetta, Velleeta, Chitoora, and Kanjoora—are also commonly used.
- Historical records indicate that **tribal communities once presented Kannadippaya mats to royalty as a gesture of honour, highlighting its cultural and social significance.**

Geographical Indications (GI) and Associated Laws

Geographical Indications (GIs) **are intellectual property rights** that identify goods as originating from a specific geographical location, where their quality, reputation, or other characteristics are directly linked to that origin. Below is an overview of GI laws in India and globally.

GI Laws in India

- **Legal Framework:** Governed by the **Geographical Indications of Goods (Registration and Protection) Act, 1999,** which came into effect in 2003. Section 2(1)(g) defines GIs as marks identifying goods based on their geographical origin and associated qualities, reputation, or characteristics.
- **Registration Process:** Producers or associations file applications with the Geographical Indications Registry. The process involves scrutiny, publication in the GI Journal, and objections (if any), followed by registration.
- **Validity:** GI tags are valid for **10 years and can be renewed indefinitely.**
- **Key Features:** Covers agricultural goods, natural goods, and manufactured goods. Protects against unauthorised use of registered GIs.
- **Examples: Darjeeling Tea** (first GI tag in India, 2003), Pashmina Shawls, and Alphonso Mangoes.
- **Benefits:** Promotes rural development by protecting traditional knowledge and fostering economic growth. Enhances marketability of products by ensuring authenticity.

Global Laws on GIs

- **World Trade Organisation (WTO):** Governed by the **Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement (1995).** Article 22 defines GIs as indications identifying goods based on their geographical origin and associated qualities or reputation.
- **TRIPS mandates:** Minimum protection for all GIs to prevent misleading usage and unfair competition. Higher protection for wines and spirits under Article 23.
- **World Intellectual Property Organisation (WIPO):** Administers treaties like:
  - **Paris Convention (1883):** Provides general protection for industrial property, including GIs.
  - **Lisbon Agreement (1958):** Focuses on appellations of origin with stricter protection standards.
  - **Geneva Act of the Lisbon Agreement (2015):** Expands coverage to all GIs beyond appellations of origin.

Pandita Ramabai

Sub Topic: Modern Indian history from about the middle of the eighteenth century until the present- significant events, personalities, issues.

Context:

103rd Death Anniversary of social reformer Pandita Ramabai.

Who was Pandita Ramabai?

- Pandita Ramabai was an **Indian social reformer**, a pioneer in the **education** and **emancipation of women** in the **late 19th** and **early 20th centuries**.
- Born in 1858 to a Brahmin family, she remarkably mastered Sanskrit and other classical literature, defying the norms of her time.

Social Reforms:

- Witnessing the plight of women, particularly widows and those who were marginalised, she dedicated her life to improving their status.
- She founded the **Arya Mahila Samaj** to promote women's education and address their issues.
- Her most significant work was the establishment of the **Sharda Sadan** in 1889, a refuge and learning centre for widows, providing them with education, vocational training, and a chance at a dignified life.
- Later, she founded **Mukti Mission**, a broader institution that sheltered and educated widows, orphans, and other disadvantaged women.
- Beyond institutions, Ramabai challenged societal norms through her writings and speeches, advocating for women's rights to education and property.
- One of her most notable works is "***The High-Caste Hindu Woman***", published in 1887. In this book, she critiques the oppressive conditions faced by women in Hindu society.
- Her conversion to Christianity added complexity to her legacy, yet her commitment to social reform remained unwavering.

Arya Samaj

Sub Topic: *Modern Indian history from about the middle of the eighteenth century until the present- significant events, personalities, issues.*

Context:

150th Anniversary of the foundation of the Arya Samaj.

Arya Samaj: Foundation and Core Objectives

- The **Arya Samaj** is a **Hindu reform movement** founded by **Swami Dayananda Saraswati** on **10 April 1875** in **Bombay** (now **Mumbai**).
- It aimed to **revitalise Hinduism by promoting monotheism** and the **authority of the Vedas** as the ultimate source of knowledge.
- Swami Dayananda sought to eradicate social evils such as **caste discrimination**, **idol worship**, **child marriage**, and **Sati**, while advocating for **widow remarriage**, **women's empowerment**, and **education**.
- The movement emphasised **rationalism**, **equality**, and **universal brotherhood**, encapsulated in its **ten principles** that encourage truthfulness, social justice, and the progress of humanity.

Dayanand Saraswati:

- **Dayanand Saraswati** (**1824–1883**), originally named **Mool Shankar Tiwari**, was a **Hindu philosopher**, **social reformer**, and founder of the **Arya Samaj**.
- His early education focused on **Sanskrit** and **Vedic scriptures**, but his spiritual journey took a transformative turn at the age of **14**.
- Witnessing a **mouse nibbling** offerings at a **Shiva idol** during **Shivaratri** led him to **question idol worship** and **reject ritualistic practices**.
- This incident marked the beginning of his lifelong mission to purify Hinduism by returning to Vedic principles.
- Dayanand renounced worldly life at the age of 21 and became a wandering ascetic, studying under various scholars and sages.
- Guided by his **guru Virajanand Dandeesha**, he delved into the **Vedas** and **Upanishads**, developing his philosophy rooted in truth, righteousness, and rationality.
- **Satyarth Prakash (The Light of Truth):** His seminal work outlined his philosophical views on the Vedas and criticised practices like idol worship and rituals. It remains one of the most influential texts for understanding Vedic philosophy.
- He was among the first to call for **Swaraj** ("***India for Indians***") in **1876**, inspiring leaders like **Lokmanya Tilak** during India's independence struggle.

Revivalists vs Reformists in Colonial India:

- **Revivalists**, such as **Arya Samaj** and **Ramakrishna Mission**, sought to reconnect with India's ancient traditions and scriptures to address contemporary issues. They emphasised returning to the spiritual roots of Hinduism, often using Vedic or Upanishadic teachings as a guide.
- **Reformists**, including **Brahmo Samaj** and **Prarthana Samaj**, were more inclined towards adopting **modern values influenced by Western thought**. They focused on eradicating outdated practices while introducing progressive reforms like women's rights and secular education.

Mains

Parliamentary Panel Calls for Higher Income Limit for OBC Creamy Layer Exclusion

Sub Topic: *Indian Constitution—historical underpinnings, evolution, features, amendments, significant provisions and basic structure.*

Context:

A parliamentary committee examining the welfare of Other Backward Classes (OBCs) has recommended **raising the income ceiling for the exclusion of the "creamy layer," arguing that the current threshold of ₹8 lakh, set in 2017, is outdated and insufficient.**

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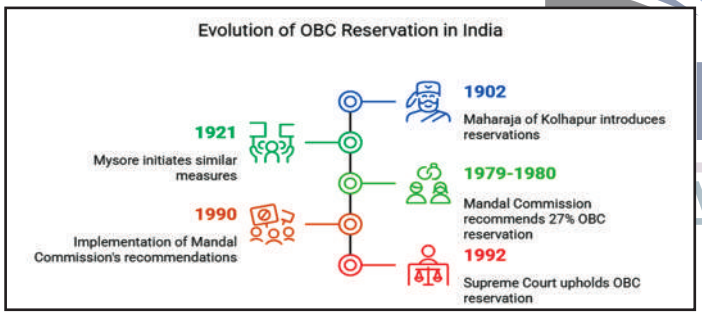
- The committee emphasised that **increasing this limit is essential to ensure a broader section of OBCs can benefit from reservation policies and government welfare schemes.**



Need for Revision

- The concept of the **"creamy layer"** was introduced following the Supreme Court's landmark **Indra Sawhney judgment in 1992.**
- This provision was intended **to exclude socially advanced segments within OBCs** from availing of reservation benefits.
- The **income threshold for determining the creamy layer was initially set at ₹1 lakh in 1993** and has been revised periodically, with the last adjustment occurring in 2017.
- In its reports tabled in the Lok Sabha on April 1, 2025, the Parliamentary Committee on the Welfare of OBCs urged the government to conduct consultations with stakeholders and establish a significantly higher income ceiling.
- The panel believes that a **revision is necessary to reflect inflationary trends and ensure that OBC reservations effectively benefit those who need them the most.**

Transparency in Reservation Data

- The committee also recommended **greater transparency in the implementation of OBC reservation quotas in Central government jobs.**
- It urged the **Department of Personnel and Training (DoPT) to include data on OBC representation in its annual reports** and publish it online for public access.
- While the DoPT has developed the **Representation of Reserved Categories in Posts and Services (RRCPS)** portal to collect and monitor such data, the committee noted that access is currently restricted to ministries and the DoPT itself.
- The call for transparency follows a report which highlighted that the **DoPT's 2023-24 Annual Report omitted reservation data for the first time in at least two decades.**
  - At the time, the DoPT attributed this omission to an inability to compile the data in time.

Ensuring Uniformity Across States

- The committee also raised concerns about discrepancies in **how different state governments calculate the creamy layer income threshold.**
  - It noted that **states follow varied methods** to determine which sources of income are considered while assessing eligibility.
  - To address this inconsistency, **the panel recommended that the Centre engage with states to develop a uniform approach as much as possible.**
- Additionally, the committee urged the government to **expedite the process of establishing post-equivalence between autonomous bodies and Central and state government services.**
  - The delay in defining such equivalence has reportedly led to qualified OBC candidates who have cleared the UPSC Civil Services Examination being denied service allotments.

Enhancing Educational Opportunities

- The panel also advocated for **revising the income limit for OBC student scholarships.**
  - Currently, **an income threshold of ₹2.5 lakh** applies for pre- and post-matric scholarships.

- The committee recommended **doubling this limit** for pre- and post-matric scholarships and implementing a "suitable rise" for top-class scholarships covering school and college education.

- Moreover, it questioned **why the pre-matric scholarship program for OBCs is currently limited to students in Classes IX and X.**
  - The panel proposed **expanding the scheme to include students from Class V onwards.**
  - It further recommended increasing the number of available slots for top-class school education scholarships, which presently stand at 15,000, citing the high demand among OBC, Economically Backward Class (EBC), and Denotified Nomadic Tribes (DNT) students.

India's Growing Battle Against Disinformation

Sub Topic: *Government policies and interventions for development in various sectors and issues arising out of their design and implementation.*

Context:

The **World Economic Forum's (WEF) Global Risks Report 2025** has **identified misinformation and disinformation as the most significant short-term global threat.**

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- According to the WEF, **a global risk is any event that can negatively impact a significant portion of the population, global GDP, or natural resources.**
- The rapid evolution of **AI-generated content, algorithmic biases, and deepening societal divisions** are making it increasingly difficult to distinguish between fact and fiction.

Information Disorder in India

- **Huge Base of Users:** As India approaches **900 million internet users,** the country faces heightened **vulnerability to misinformation,** particularly **in the absence of robust policies to counteract disinformation.**
  - India's **diverse political and social landscape** creates a fertile ground for the spread of manipulated narratives, voter influence tactics, and economic disruptions.
  - The **crisis extends beyond politics, fueling consumer boycotts, economic disputes, and international tensions.**
- **Public Trust: Public trust in traditional media is waning,** allowing political entities and non-state actors to exploit this gap by propagating misleading information.
  - With **mainstream media credibility declining, citizens increasingly rely on social media for news,** often forwarding unverified content shared by family and friends.
  - This **unchecked circulation of false information has profound implications for national discourse and governance**.
- **Tech Oligarchy:** Former U.S. President Joe Biden's warning about an emerging ***"tech oligarchy"*** underscores the **urgency for India to implement policy changes similar to the European Union's Digital Services Act,** aimed at countering disinformation and foreign information manipulation.

Deepening Crisis

- **Prominent Uses:** Prominent **politicians and national political parties** in India have been found sharing **deepfake content and unverified information,** exacerbating the country's disinformation crisis.
- **Disinformation Target:** India, as an emerging global power, has **long been a target of Chinese disinformation campaigns,** particularly since the **2017 Doklam standoff.**
  - In response, the **Indian government banned over 300 Chinese apps, including TikTok, to curb foreign interference.**
- **Severity of Disinformation:** A study conducted by the **Indian School of Business and the CyberPeace Foundation** highlights the **alarming prevalence of political disinformation,** which accounts for **46% of misleading content, followed by general misinformation (33.6%)** and **religious content (16.8%).**
  - **Chinese platforms** such as Weibo have **actively sought to distort India's global image, exacerbating geopolitical tensions.**
  - The potential **discontinuation of Meta's fact-checking partnerships**, as seen in the U.S., could further intensify these risks.
- **Consequences for Democracy:** With India's youth increasingly exposed to misinformation, the **consequences for its democratic and social fabric** could be severe.
  - The Global Risks Report 2025 also notes that **people in high-income nations are generally more concerned about misinformation risks** than those in lower-income countries, with some exceptions.

World Economic Forum (WEF)

The World Economic Forum (WEF) is an international organisation based in **Cologny, Switzerland, founded in 1971 by Klaus Schwab.** It serves as a **platform for public-private cooperation,** bringing together leaders from business, politics, academia, and civil society to address global challenges

and shape agendas on economic, social, and environmental issues. The WEF is **best known for its annual meeting in Davos, Switzerland, which gathers thousands of influential figures to discuss pressing global issues. The major reports published by WEF** are Global Competitiveness Report, Global Gender Gap Report, Global Risks Report, Energy Transition Index (ETI), Global Travel and Tourism Report, Global Cooperation Barometer.

Proposed Measures to Counter Disinformation

- **Holistic Measures:** To combat the growing crisis, the Global Risks Report 2025 outlines several key recommendations, including **upskilling developers working with algorithms, enhancing public awareness and digital literacy,** and **ensuring accountability through supervisory boards and AI councils** to oversee generative AI practices.
  - Initiatives such as **Shakti – India Election Fact-Checking Collective** and the **Deepfake Analysis Unit** played an instrumental role in tackling misinformation during the 2024 general elections.
- **Leveraging the Market:** India, with nearly **400 million Facebook users and over 500 million WhatsApp users,** represents the **largest market for social media platforms.**
  - This **market power can be leveraged to push major tech firms toward implementing stronger policies against disinformation.**
  - Measures such as **risk assessments for Very Large Online Platforms** (those with over 45 million users), inspired by the EU's Digital Services Act, could enhance digital accountability.
- **Balanced Approach:** However, a balanced approach is necessary to **avoid unintended consequences such as increased surveillance,** which could undermine democratic freedoms.
  - The WEF report highlights **censorship and surveillance as additional global risks** that must be addressed alongside misinformation.
- **Risk Assessments: Regulatory bodies should mandate periodic risk assessments** for social media platforms and allocate funding to advance cybersecurity research and innovation.
  - **Transparent content moderation policies** must be implemented to mitigate the spread of misleading content that threatens public health, safety, or democracy, while ensuring non-discriminatory enforcement.
- **Funding:** Online advertisements must disclose **funding sources and targeted audiences to prevent malicious actors from manipulating public perception.**
- **Awareness:** Public awareness initiatives, such as the **Reserve Bank of India's Financial Literacy Campaign** featuring Amitabh Bachchan, should be expanded to promote critical thinking and societal resilience against misinformation.
- **Civil Society:** Collaboration among **civil society groups, fact-checkers, and regulators** is essential to create evidence-based policies for maintaining information integrity.
- **Independent Research:** Additionally, independent research on disinformation and Foreign Information Manipulation and Interference (FIMI) should be supported through dedicated funding and legislative safeguards for journalists.

AI-Generated Child Sexual Abuse Material (CSAM)

Sub Topic: *Important aspects of governance, transparency and accountability, e-governance- applications, models, successes, limitations, and potential; citizens charters, transparency & accountability and institutional and other measures.*

Sub Topic: *Comparison of the Indian constitutional scheme with that of other countries.*

Context:

The Department for Science, Innovation and Technology (UK) and the AI Safety Institute (now AI Security Institute) released the **International AI Safety Report 2025**, warning of the imminent risk of **AI tools** being used to create, possess, and disseminate **Child Sexual Abuse Material (CSAM)**.

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- The UK government is making its first legislative attempt to address these threats, targeting **AI tools** capable of generating CSAM.
- The **World Economic Forum (2023)** and the **Internet Watch Foundation (October 2024)** have flagged the increasing prevalence of AI-generated CSAM.

Overview

- **CSAM** refers to any material (images, videos, audio) depicting sexually explicit portrayals of children.
- The **digital world** has created a global market for CSAM, allowing material to be shared across borders, and providing anonymity to perpetrators.
- Technology has also enabled **end-to-end encryption** on social media platforms, allowing abusers to trade CSAM within closed, often paid, groups without facing repercussions.
- Each view of CSAM contributes to the demand for more content, fostering the cycle of exploitation and abuse. Research shows that nearly **half of those who view CSAM** attempt to make contact with children to further abuse them.

Monetisation and Digital Crimes

- Technological developments have facilitated the **monetisation** of child sexual abuse, such as the ability to pay to watch **live-streamed abuse** on the dark web.
- The rise of **sextortion**, where criminals threaten to expose explicit images or videos of children unless paid, has also been fueled by technology.

Long-Term Impact on Victims

- Child sexual abuse has **lifelong psychological and emotional consequences**.
- Each time an image or video is shared, the victim's **privacy is repeatedly violated**.
- Victims fear that **friends, family, or the public may see** their abuse material.

Key Legislative Developments in the UK

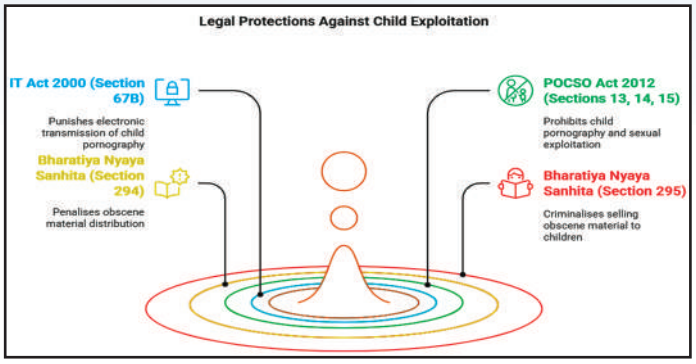
- The UK's upcoming legislation will **criminalise**: The **possession**, **creation**, or **distribution** of AI tools designed to generate CSAM. Possession of **paedophile manuals** that guide individuals in using AI to generate CSAM.
- This marks a shift from an **'accused-centric'** and **'act-centric'** approach to **'tool-centric'** legislation, focusing on the **tools and mediums** used to commit crimes rather than just the individuals performing the act.
- The **Protection of Children Act 1978 (UK)** and **Coroners and Justice Act 2009 (UK)** focus on criminalising **actual** child abuse images.
- The new legislation, however, will also prohibit **AI-generated** CSAM, closing an existing loophole.

Key Benefits of the new approach:

- It helps in apprehending offenders **at the preparation stage**.
- It aims to limit the **spread of CSAM**, addressing the mental health toll it causes, particularly on children.
- It tackles **AI-generated CSAM**, which previously wasn't adequately addressed in existing laws focused on images of actual children.

The Situation in India

- According to the **National Crime Records Bureau (NCRB)** 2022, cybercrimes against children have increased dramatically.
- The **National Cyber Crime Reporting Portal (NCRP)**, under the **Cyber Crime Prevention against Women and Children (CCPWC)** scheme, reported **1.94 lakh** incidents of child pornography as of April 2024.
- The NCRB's **memorandum of understanding** with the **National Centre for Missing and Exploited Children (NCMEC)**, USA has facilitated the sharing of **69.05 lakh cyber tip-line reports** related to CSAM.
- These reports highlight the **grave** nature of the CSAM threat to children's rights in India.



Need for Legislative Adaptation in India

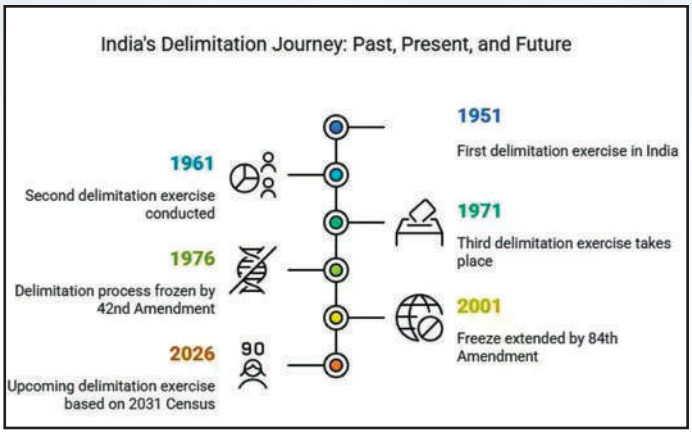
- **Update Definitions**: Replace the term **'child pornography'** in the POCSO Act with **'CSAM'** to make the definition more expansive and relevant to emerging technologies.
- **Define 'Sexually Explicit'**: Clarify the term **'sexually explicit'** under **Section 67B of the IT Act** to facilitate the **real-time identification** and **blocking** of CSAM.
- **Update Definition of 'Intermediaries'**: Include **Virtual Private Networks (VPNs)**, **Virtual Private Servers (VPS)**, and **Cloud Services** under the **'intermediary'** definition in the IT Act to ensure they comply with CSAM-related laws.
- **Statutory Amendments for Emerging Tech**: Amend laws to address the **risks posed by AI technologies** in generating CSAM.
- **International Cooperation**: Pursue the **adoption of the UN Draft Convention on 'Countering the Use of ICT for Criminal Purposes'** by the UN General Assembly to strengthen global cooperation in tackling AI-enabled crimes.
- **Update Digital India Act**: The **Digital India Act 2023**, proposed to replace the outdated IT Act of 2000, must include provisions inspired by the **UK's upcoming legislation**, specifically targeting **AI-generated CSAM**.

Reimagining Delimitation: Balancing Representation, Population, and Federal Equity

Sub Topic: *Functions and responsibilities of the Union and the States, issues and challenges pertaining to the federal structure, devolution of powers and finances up to local levels and challenges therein.*

Context:

Delimitation — the redrawing of parliamentary and assembly constituencies — as mandated by **Articles 82 and 170 of the Indian Constitution,** has reignited fierce **debates across the country.**



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- On one end of the spectrum are **concerns rooted in the letter of the Constitution** and **its implications if applied as intended.**
- On the other, **some have responded with alarmist and even humorous suggestions,** such as **encouraging rapid population growth to avoid being politically outnumbered.**
- As emotions flare, there is a **pressing need to step back and examine the issue with objectivity.**

Constitutional Mandate and Emerging Anxieties

- **After Each Census:** According to the Constitution, **following every census,** the **allocation of Lok Sabha seats among states and the division of state territories into constituencies must be recalibrated.**
  - A **similar directive applies to state legislative assemblies.**

42nd Amendment: However, the 42nd and later amendments **froze this readjustment until 2026,** with the next delimitation to be based on the census conducted thereafter.

- **Concerns:** This provision has sparked concern, particularly among **southern states**, **fearing they will lose representation despite their success in population control.**
  - Though evidence supporting these fears is limited, their sentiments deserve acknowledgment.

Federalism and the Flawed Logic of Purely Population-Based Representation

- At the heart of the debate is the **tension between population-based representation and federal equity.**
- **Relying solely on population to determine seat allocation rewards states with higher population growth** — often at the cost of those that implemented responsible population control measures.
  - This creates an **inherent imbalance in the spirit of cooperative federalism.**
- **Historical data reflects a gradual expansion of Lok Sabha seats** — from **489 in 1951 to 543 today** — driven by delimitation exercises.
  - However, there has **never been a fixed formula to determine the ideal population-to-seat ratio.**
  - While the **average population per Lok Sabha seat rose from 7.32 lakh in 1951 to about 27 lakh in 2024, Vidhan Sabha seats saw a similar trajectory.**
  - This growth is not just numerical but has political and logistical consequences.

Representation: Beyond Numbers

- While **population has been the primary factor** in determining representation, it has **not been the only one.**
- Other considerations such as **geographical continuity, administrative boundaries, and regional concerns** have also shaped electoral maps.
  - This raises a deeper question: ***what does it mean to "represent" a constituency?***
- A Member of Parliament or a legislative assembly **does not derive more authority or legitimacy based on the size of their electorate.**
  - Their role in legislative processes, committee participation, and oversight functions remain unchanged.
- Moreover, **there is little evidence to suggest that smaller constituencies lead to better representation or governance.**
  - Instead, **strengthening grassroots democracy and empowering local self-governments may offer a more meaningful improvement in governance.**

Moderating Population as a Criterion

- **Balanced Approach:** Given the central government's active promotion of population control in the past, penalising states that succeeded in implementing these policies seems counterproductive.
  - A kind of **"population deflator"** — similar to how real GDP is adjusted for inflation may be adopted.
- **Using TFR:** One possible model is to **adjust population figures using the Total Fertility Rate (TFR),** a key determinant of population growth.
  - For instance, while the current population might suggest the Lok Sabha should have over 1,400 seats (using 1977's 10.10 lakh average), adjusting for the TFR might reduce this to a more manageable and equitable number like 680.
  - **State-specific TFR data could further refine this adjustment,** ensuring that states are not unfairly disadvantaged for controlling population growth.

What India needs is a **mature, inclusive, and nuanced dialogue** — one that balances constitutional mandates with present realities, federal fairness, and the foundational principle of ***"one person, one vote."***

Corruption and Judicial Independence

Sub Topic: Separation of powers between various organs dispute redressal mechanisms and institutions.

Context:

The Supreme Court's initiation of a **three-member judicial inquiry into allegations against Justice Yashwant Varma** marks a significant step towards upholding judicial integrity.

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- Chaired by Justices Sheel Nagu, G.S. Sandhawalia, and Anu Sivaraman, the inquiry **underscores the judiciary's commitment to transparency and accountability.**

Presumption of Innocence and Judicial Integrity

- In our adversarial legal system, the **presumption of innocence is paramount.**
- **Justice Varma's denial of wrongdoing and claims of a conspiracy** highlight the necessity for a fair and impartial investigation.
- Chief Justice of India Sanjiv Khanna's proactive measures, including Justice Varma's transfer to the Allahabad High Court and his temporary de-rostering, demonstrate a **balanced approach to maintaining public confidence while ensuring due process.**

Debate on Judicial Appointments: Diverse Perspectives

- The **National Judicial Appointments Commission (NJAC),** established through the 99th Constitutional Amendment, aimed to reform this process by involving a broader panel in judicial selections.
  - However, in 2015, the **Supreme Court struck down the NJAC**, deeming it **unconstitutional for potentially compromising judicial independence.**
- **Justice Jasti Chelameswar,** in his dissenting opinion, **supported the NJAC,** arguing that the **collegium system lacked transparency and accountability.**
  - He believed that involving the executive and eminent persons in the appointment process would enhance its credibility and reflect democratic principles.
- **Justice Madan Lokur,** conversely, **opposed the NJAC,** expressing concerns that it might lead to a ***"committed judiciary"*** aligned with the executive, thereby undermining judicial independence.
  - He emphasised the **necessity of insulating judicial appointments from external influences to preserve the judiciary's impartiality.**
- **Eminent jurist Fali S. Nariman** also **criticised the NJAC,** highlighting that the **inclusion of non-judicial members could erode the independence of the judiciary.**
  - He advocated for **reforms within the collegium system** to enhance transparency without compromising judicial autonomy.
- **Justice Markandey Katju** has been vocal about the need for reforms in judicial appointments, **criticising both the collegium system and the NJAC.**
  - He has called for **a more transparent and merit-based selection process** to ensure the appointment of competent and independent judges.

Constitutional Provisions: Articles 124A, 124B, and 124C

The 99th Constitutional Amendment introduced **Articles 124A, 124B, and 124C,** which outlined the framework for the NJAC:

- **Article 124A:** It established the **composition of the NJAC,** including the **Chief Justice of India as Chairperson, two senior Supreme Court judges, the Union Minister of Law and Justice, and two eminent persons** nominated by a committee comprising the Prime Minister, the Chief Justice of India, and the Leader of Opposition in the Lok Sabha.
- **Article 124B:** It detailed the **NJAC's functions,** primarily recommending appointments and transfers of judges in the Supreme Court and High Courts, ensuring individuals of integrity and ability are selected.
- **Article 124C:** It **empowered Parliament to legislate on the procedures for the NJAC's functioning, allowing the commission to frame regulations for discharging its duties.**

Fiscal Health Index 2025

Sub Topic: *Government policies and interventions for development in various sectors and issues arising out of their design and implementation.*

Sub Topic: *Functions and responsibilities of the Union and the States, issues and challenges pertaining to the federal structure, devolution of powers and finances up to local levels and challenges therein.*

Context:

The Fiscal Health Index (FHI) initiative, **introduced by NITI Aayog,** is **designed to evaluate and understand the financial stability of Indian states.**

More on News

- **This index covers eighteen major states,** which significantly contribute to the country's GDP, public expenditure, revenue generation, and overall fiscal discipline.
- **Odisha emerges as the frontrunner in the latest index,** followed by **Chhattisgarh, Goa, Jharkhand, and Gujarat.**
- Given that **Indian states account for nearly two-thirds of public spending and one-third of total revenue,** their fiscal management plays a crucial role in maintaining national economic stability.

Achiever	Front Runner	Performer	Aspirational
Odisha (1)	Maharashtra (6)	Tamil Nadu (11)	Kerala (15)
Chhattisgarh (2)	Uttar Pradesh (7)	Rajasthan (12)	West Bengal (16)
Goa (3)	Telangana (8)	Bihar (13)	Andhra Pradesh (17)
Jharkhand (4)	Madhya Pradesh (9)	Haryana (14)	Punjab (18)
Gujarat (5)	Karnataka (10)		

Objectives of the Fiscal Health Index

The FHI aims to:

- Provide a **comparative assessment** of fiscal health across states using standardised metrics.
- **Identify strengths and areas of concern** in state fiscal management.
- Promote **transparency, accountability,** and prudent financial governance.
- **Assist policymakers** in enhancing fiscal sustainability and resilience.

Key Indicators Evaluated

The Fiscal Health Index 2025 is built upon a comprehensive set of indicators categorised into five broad areas:

- **Tax Buoyancy:** This measures the responsiveness of tax revenue growth to economic activity, evaluating states' efficiency in revenue mobilisation.
- **Debt-to-GSDP Ratio:** This metric compares a state's total debt with its Gross State Domestic Product (GSDP), reflecting its debt repayment capability.
- **Expenditure Management and Prioritisation:** Assesses how efficiently states allocate expenditures, particularly in capital outlays and fiscal discipline.
- **Debt Management:** Examines states' debt sustainability, including interest payment burdens and overall debt portfolio health.
- **Fiscal Deficit Management:** Measures fiscal deficit as a percentage of GSDP and adherence to statutory limits.

Key Findings

- **Top Performers: Odisha leads the Fiscal Health Index** with a **score of 67.8,** excelling in Debt Index (99.0) and Debt Sustainability (64.0). Its fiscal prudence is reflected in a low fiscal deficit and a robust capital outlay to GSDP ratio.
  - **Chhattisgarh (55.2) and Goa (53.6) rank second and third**, excelling in debt sustainability and revenue mobilisation, respectively.
- **Strong Non-Tax Revenue States: Odisha, Jharkhand, Goa, and Chhattisgarh** have effectively **leveraged non-tax revenue sources, averaging 21% of total revenue.**

States	FHI Score	Rank 2022-23	Quality of Expenditure	Revenue Mobilization	Fiscal Prudence	Debt Index	Debt Sustainability
Odisha	67.8	1	52.0	69.9	54.0	99.0	64.0
Chhattisgarh	55.2	2	55.1	56.5	56.0	79.6	29.0
Goa	53.6	3	45.5	87.1	59.4	51.0	25.2
Jharkhand	51.6	4	47.3	45.7	62.4	66.9	35.7
Gujarat	50.5	5	40.0	48.7	52.7	69.0	42.0
Maharashtra	50.3	6	37.1	59.1	41.8	76.4	36.8
Uttar Pradesh	45.9	7	45.8	34.6	44.7	59.9	44.5
Telangana	43.6	8	36.9	75.2	40.8	53.3	11.7
Madhya Pradesh	42.2	9	59.7	27.6	35.6	61.0	27.2
Karnataka	40.8	10	47.4	43.9	43.9	62.2	6.7
Tamil Nadu	29.2	11	32.0	41.2	25.8	36.0	11.1
Rajasthan	28.6	12	38.3	35.4	19.9	32.3	16.8
Bihar	27.8	13	56.1	5.3	11.5	47.2	18.8
Haryana	27.4	14	24.8	47.8	26.1	24.1	14.3
Kerala	25.4	15	4.2	54.2	34.0	23.1	11.3
West Bengal	21.8	16	32.3	12.4	25.4	18.3	20.6
Andhra Pradesh	20.9	17	31.4	22.1	13.3	37.8	0.0
Punjab	10.7	18	4.7	28.1	5.6	0.0	15.2

  - **Odisha benefits from mining premiums,** while Chhattisgarh capitalises on coal block auctions.
- **States Facing Fiscal Challenges: Punjab, Andhra Pradesh, West Bengal, and Kerala** struggle with high fiscal deficits, poor debt sustainability, and low-quality expenditure.
- **Capital Expenditure Allocation:** States like **Madhya Pradesh, Odisha, Goa, Karnataka, and Uttar Pradesh** allocate around 27% of their Developmental Expenditure to Capital Expenditure, whereas West Bengal, Andhra Pradesh, Punjab, and Rajasthan allocate only 10%.
- **Debt Sustainability Concerns:** West Bengal and Punjab face rising debt-to-GSDP ratios, highlighting the risk of unsustainable debt burdens.

Sustainability of Debt Portfolios

Debt sustainability is critical to a state's ability to meet financial obligations without requiring external bailouts. The FHI evaluates this by analysing solvency and liquidity indicators:

- **Top Performers:** Odisha, Chhattisgarh, and Goa lead in Debt Index, Debt Sustainability, and Revenue Mobilisation.
- **Debt Index and Interest Payment Ratios:** The ratio of Interest Payments to Revenue Receipts (IP/RR) indicates how much of a state's revenue is allocated for debt servicing.

- **Challenges for Aspirational States:** Punjab, Andhra Pradesh, West Bengal, and Kerala struggle with high fiscal deficits and mounting debts, threatening their long-term fiscal health.

Supreme Court's Role in Ensuring Timely Action on Anti-Defection Cases

Sub Topic: *Structure, organisation and functioning of the Executive and the Judiciary—Ministries and Departments of the Government; pressure groups and formal/informal associations and their role in the Polity.*

Context:

Recently, **Justice Bhushan Ramakrishna Gavai** emphasised that the **court is not powerless** if a Speaker remains indecisive on disqualification pleas under the **Tenth Schedule**.

Tenth Schedule and Its Objective

- The **Tenth Schedule** was introduced by the **52nd Constitutional Amendment Act, 1985** to curb **political defection** and ensure **party discipline**.
- It provides for the **disqualification of legislators** if they **voluntarily give up membership** of their party or **vote against the party's directive**.
- The **Speaker** acts as a **quasi-judicial authority** to decide on **disqualification petitions**.

Challenges in Implementing the Anti-Defection Law

- **Partisan Role of the Speaker:** As a **member of the ruling party**, the Speaker's decisions may be **influenced by political considerations**.
- **Lack of a Defined Timeframe:** The **Constitution** and **Rules of Procedure** do not specify a **deadline** for deciding **disqualification petitions**.
- **Judicial Limitations:** Courts **exercise judicial review** only **after the final decision** of the Speaker, making **timely intervention difficult**.

Key Legal Issue: Timeframe for Decision on Disqualification Petitions

- The main legal question is whether **constitutional courts** can direct **Speakers** to decide disqualification petitions **within a specific timeframe**.
- **Justice Gavai** raised concerns that **indecision by a Speaker** should not defeat the purpose of the **Tenth Schedule**.
- The case pertains to **Bharat Rashtra Samithi (BRS) leaders** seeking timely action by the **Telangana Assembly Speaker** on disqualification petitions against MLAs who **defected to the ruling Congress party**.

Key Observation of Supreme Court on Judicial Review and Speaker's Authority

- The Supreme Court acknowledged that while it **cannot dictate how a Speaker should decide**, it can set a **reasonable timeframe for decision-making**.
- **Senior Advocate Mukul Rohatgi**, appearing for the respondents, argued that the Speaker, as a **Constitutional authority**, should not be bound by a strict deadline.
- **Justice Gavai** countered that the Supreme Court's **"request"** to a Speaker carries **legal weight** and non-compliance may invoke **Article 142**.
- **Article 142** grants the Supreme Court the power to **pass any decree necessary to ensure complete justice**.

Previous Judicial Interventions

- The **Supreme Court** has previously intervened in cases of **long-pending disqualification petitions**.
- **Justice C.A. Sundaram** pointed out that **Speakers**, despite being expected to act impartially, often exhibit **political partisanship**.
- The **lack of a fixed timeline** creates room for **delays and manipulation**.
- The **Telangana High Court** had earlier ruled that a **Speaker must decide within a reasonable time**.

Pros of the Supreme Court's Decision

- **Strengthens Constitutional Governance and Rule of Law:** Ensures that the Tenth Schedule is not rendered ineffective due to delays by the Speaker. Reinforces constitutional mandates that uphold democratic principles and party discipline
- **Judicial Oversight Enhances Accountability:** The use of Article 142 ensures justice in cases where procedural loopholes are exploited.
- **Strengthens Legislative Integrity and Stability:** Ensures that the mandate given by voters is not undermined through post-election defections.

Cons of the Supreme Court's Decision

- **Undermines Separation of Powers:** The ruling allows the judiciary to set deadlines for the Speaker, who is a legislative authority.
- **Weakens Legislative Autonomy: The Speaker, as a constitutional authority, may face interference in his discretionary powers.**
- **Challenges the Finality of Speaker's Authority:** The Tenth Schedule originally intended to make the Speaker's decision final on disqualification matters.
- **Implementation Challenges in Future Cases:** If courts start enforcing strict timelines, Speakers may be forced to rush decisions without proper deliberation.

Legal and Constitutional Implications

- **Tenth Schedule**: Prevents **political defections** to maintain **government stability**.
- **Judicial Review**: Courts ensure **compliance with constitutional mandates**.
- **Article 142**: Empowers the **Supreme Court** to pass **orders to uphold justice**.
- **Impact on Governance**: Political uncertainty arises when **defecting MLAs** retain their seats **without consequence**.

Way Forward

- **Fixing a Mandatory Timeline:** The law should specify a **maximum period** within which the **Speaker must decide** on **disqualification petitions**.
- **Independent Tribunal for Disqualification:** Transferring **disqualification powers** from the **Speaker** to an **independent tribunal**, such as the **Election Commission**, can ensure **neutrality**.
- **Judicial Oversight:** The **Supreme Court's power under Article 142** can be invoked in cases of **excessive delay**.
- **Amendment to the Tenth Schedule:** A constitutional amendment can introduce safeguards against undue delays.

India Justice Report 2025

Sub Topic: *Structure, organisation and functioning of the Executive and the Judiciary—Ministries and Departments of the Government; pressure groups and formal/informal associations and their role in the Polity.*

Context:

Delhi has emerged as a **frontrunner in multiple law enforcement and justice delivery metrics**, according to the India Justice Report (IJR) 2025.

Delhi Sets Benchmark in Women's Representation in Police Force

- The national capital is the **only state or Union Territory that has fully implemented the Ministry of Home Affairs (MHA) recommendation** of appointing **at least three women sub-inspectors and 10 women constables per police station**.
- As of January 2023, **Delhi exceeded these benchmarks, averaging 4.7 women sub-inspectors and 41 women constables per police station.**

More Insights

The India Justice Report (IJR) 2025 is the **country's only comprehensive ranking of states based on the delivery of justice**. Initiated by **Tata Trusts in 2019**, produced in **collaboration with several civil society organisations,** the report assesses states on **four critical pillars: *police, judiciary, prisons, and legal aid.***

Top Performers and Rankings

- **Karnataka** tops the list, followed by Andhra Pradesh, Telangana, Kerala, and Tamil Nadu.
- **West Bengal ranks at the bottom,** with Uttar Pradesh, Uttarakhand, Jharkhand, and Rajasthan also performing poorly.
- Among small states, **Sikkim is the best performer, while Goa is at the bottom.**

National Systemic Issues

- **Police:** The national police-population ratio is **stagnant at 155 per 100,000,** well below the **sanctioned 197.5. Bihar fares the worst (81 per lakh).**
- **Prisons:** Over the last decade, the prison population surged by nearly 50%. The proportion of **undertrials rose from 66% to 76%.**
- **Judiciary:** India has only **15 judges per million people,** far below the L**aw Commission's recommendation**.
- **Legal Aid:** National per capita spend on legal aid is **just ₹6.46 per annum, and no state spends more than 1% of its budget on the judiciary.**
- **Representation: Women account for 38.3% of district judges and 14% of high court judges. SC, ST, and OBC representation remains limited, especially at higher judicial levels.**

Trends and Improvements

- Bihar showed the most improvement in policing since 2022.
- Rajasthan, Kerala, and Madhya Pradesh improved most on judicial indicators.
- Odisha and Jharkhand made the biggest gains in prison management.
- Haryana improved the most in legal aid provision.

Highest Police Training Investment in the Country

- Delhi also leads in police training expenditure, **investing ₹28,614 per police personnel** in 2021–22—**over three times the national average of ₹8,343.**
- This reflects the **Capital's commitment to enhancing law enforcement capabilities and modern policing standards.**

India's Best Judge-to-Population Ratio

- In the judicial domain, **Delhi topped the nation with 36 judges per 10 lakh (1 million) people,** far above the **national average of 15 judges per million.**
- **India, with a population of 1.4 billion,** has **only 21,285 judges—well below the 1987 Law Commission's recommendation of 50 judges per million population.**

Delhi Prisons: High e-Mulaqat Usage but Overcrowding Concerns

- The Capital has made strides in digital prison reforms.
- It recorded a **staggering 80,809 e-Mulaqat** (online prisoner meetings) in 2023, allowing inmates to stay connected with family and legal advisors.
- However, the report also highlighted **serious issues within Delhi's prison system:**
  - **Overcrowding: Three out of 16 jails had occupancy rates of over 250%** as of January 2023.
    - Since 2012, Delhi's jails have consistently recorded occupancy rates above 170%.
  - **High Undertrial Population:** A staggering **90% of prisoners in Delhi were undertrials in 2022—the highest in India.**
    - Among large states, **Bihar followed with 89%, and Odisha with 85%.**

Doctor-to-Prisoner Ratio Meets National Standard

- Delhi is one of **only four regions—alongside Arunachal Pradesh, Manipur, and Meghalaya—**that meets the Model Prison Manual's benchmark of one doctor for every 300 prisoners.
- This reflects a significant achievement in prison healthcare infrastructure.

Spending Per Inmate: Delhi Among Top Three

- Delhi ranked **third in per-inmate spending in 2022 at ₹407,** following **Andhra Pradesh (₹733) and Haryana (₹437).**
- This demonstrates a **relatively higher investment in inmate welfare and correctional services.**

Judicial Workload and Case Clearance Rate Still a Concern

Despite excelling in judge-to-population ratio, **Delhi's courts are under pressure. In 2024:**

- Each district court judge handled 2,023 cases—up from 1,551 in 2017.
- The Case Clearance Rate (CCR) stood at 78%, below the national average of 100%.
- Delhi achieved a 100% CCR only once—in 2023.

Jan Aushadhi Kendras

Sub Topic: *Government policies and interventions for development in various sectors and issues arising out of their design and implementation.*

Context:

A recent study highlights that the government's **Jan Aushadhi Kendras** have helped households in **Assam and Rajasthan** save **40% on medicines**, significantly reducing out-of-pocket healthcare expenses.

More on News

Conducted by the **Centre for Media Studies (CMS)** and funded by **Azim Premji University**, the study surveyed **496 households** across the two states, covering **331 PMBJP beneficiaries** and **165 non-beneficiaries**.

Key Findings of the Study

- **Socio-Economic Background:** The majority of PMBJP beneficiaries belong to higher socio-economic classes (**63%** were from high Standard of Living Index (**SLI**) households). Over half of these households had **at least one graduate family member,** indicating a correlation between education, standard of living, and use of Jan Aushadhi medicines.
- **Health Conditions Addressed:** The most common health issues for which PMBJP medicines were purchased were **chronic diseases.** Around **47.6%** of households bought medicines for **blood pressure, 40.5% for diabetes,** and **26.8%** for **ulcers/gastric ailments**. Additionally, **13.5%** of households purchased **cardiovascular medications**.

Savings Reported by Households

- On average, households purchasing medicines from Jan Aushadhi Kendras saved approximately **₹550 per month**.
- Notably, one-fourth of these households reported savings of more than **₹1,000 per month**, which constitutes about **3% of their household income.** The savings were utilised for various purposes, such as:
  - **Nutritious Food:** 51% of households used their savings to purchase better food for family members.
  - **Better Health Facilities:** 25% spent their savings on healthcare and treatment.
  - **Education:** 14% used the savings to fund education.
  - **House Maintenance/Assets:** 6% invested in maintaining or improving their homes.
  - **Other Purposes:** 3% allocated savings to miscellaneous needs.

The Role of Jan Aushadhi Kendras

- The PMBJP aims to provide generic medicines that are **50-80% cheaper than branded alternatives**.
- These medicines, sold at Jan Aushadhi Kendras (drug stores), make **essential medicines more accessible to economically disadvantaged families**.
- However, the study found that the beneficiaries of these stores were not exclusively from low-income groups but also from middle and upper-middle-class families who sought affordable options for managing chronic conditions.

Impact on Socio-Economic Status

- The Jan Aushadhi scheme has provided significant savings for middle-income households, helping **reduce out-of-pocket expenditures**, especially for chronic disease medications.
- The scheme's affordability has been particularly beneficial for families unable to afford branded medicines from general chemists.

Future Plans and Government Support

- For **fiscal year 2025-26**, the Indian government has allocated ₹**335.50 crore** for the continued implementation of the Jan Aushadhi scheme.
- The government's target is to open **25,000 Jan Aushadhi Kendras** across India by March 2027, aiming to expand access to affordable healthcare nationwide.
- Ravi Dadhich, CEO of the Pharmaceuticals and Medical Devices Bureau, noted that the middle-income groups have shown considerable interest in Jan Aushadhi medicines, reducing their out-of-pocket expenditures on chronic diseases. This reflects a growing trend towards the adoption of generic medicines as an effective, affordable alternative to expensive branded drugs.

Kerala Urban Policy Commission (KUPC)

Sub Topic: *Issues relating to development and management of Social Sector/Services relating to Health, Education, Human Resources.*

Context:

In a pioneering move, the **Kerala Urban Policy Commission (KUPC)** has projected that **80% of the state's population will be urban by 2050.**

More on News

- The commission, the **first of its kind in India**, recently submitted its report to Chief Minister Pinarayi Vijayan in the presence of Minister for Local Self Government and Excise M. B. Rajesh.
- **Kerala stands as the only state in India with a dedicated urban policy.**
- The report provides **insights for shaping Kerala's urban landscape over the next 25 years.**

Key Recommendations for Urban Resilience

- **Master Plan:** The commission has underscored the need for **a risk-informed master plan at the local level to integrate climate resilience into urban planning.**
  - It recommended **aligning all spatial plans with this framework to ensure cohesive and risk-sensitive development,** particularly in ecologically fragile and hazard-prone areas.
- **Green Fee:** To finance disaster risk reduction initiatives, the commission suggested levying a targeted **green fee on urban development projects.**
  - It also proposed **expanding disaster-specific insurance schemes to protect vulnerable communities and critical infrastructure.**
  - Furthermore, it called for the **establishment of a state-level climate finance advisory** cell to help local governments secure green funds, carbon financing, and international climate adaptation resources.

Reimagining Kerala's Urban Future

- The report envisions Kerala's cities evolving based on regional strengths. **It proposes:**
  - Thrissur-Kochi as a fintech hub
  - Palakkad and Kasaragod as industrial smart cities
  - Thiruvananthapuram-Kollam as a knowledge corridor fostering research and innovation
  - Kannur as a fashion city
  - Kannur-Kasaragod and Thrissur-Ernakulam as Edu Health Hubs
  - Kozhikode as the 'City of Literature' leveraging its rich literary heritage
- To achieve these transformations, the report emphasises the **importance of Industrial Revolution 4.0,** urging Kerala to strengthen MSMEs, harness high technology, promote collaboration between educational institutions and private investors, and implement a fast-track single-window licensing approval system reducing wait times to 7-15 days.

Vertical Growth and the India Infrastructure Report

- In alignment with the **India Infrastructure Report,** which advocates for vertical growth in urban development, the **KUPC report suggests that Kerala should embrace high-rise urbanisation to optimise land use,** improve public transport integration, and enhance infrastructure efficiency.

- This is particularly crucial given the state's high population density and limited horizontal expansion potential.

- The commission has also called for **ground-penetrating radar (GPR)** mapping in cities to gain a detailed view of subsurface utilities, ensuring effective infrastructure development.
  - Additionally, it recommends **systematic geo-physical surveys** for capturing subsurface strata in the midlands and plains.

Financial Challenge: India Needs $55 Billion Annually

- Kerala's urban development goals align with a national concern—the massive financial requirement for upgrading India's urban infrastructure.
- According to estimates, India needs approximately **$55 billion annually for urban infrastructure upgradation (UIU).**
- The commission stresses the **need for private-public partnerships (PPPs),** international funding, and smart urban taxation to bridge this financial gap.

Debashish Dhar's 'The Blind Spot' and Urban Planning Gaps

- Urban expert Debashish Dhar, in his book ***The Blind Spot***, highlights the critical gaps in Indian urban planning, particularly the lack of efficient governance structures and adaptive policies for urban expansion.
- The KUPC report echoes this concern, emphasising the necessity of integrated urban governance that prioritises sustainable growth while addressing local needs.

The '15-Minute City' Model for Kerala

- A transformative urban concept gaining global traction is the 15-minute city model, which **envisions urban centers where residents can access work, healthcare, education, and leisure within a 15-minute walk or bike ride.**
- The KUPC report suggests adopting this model, particularly in rapidly urbanising areas like Kochi and Thiruvananthapuram, to enhance livability, reduce congestion, and minimise carbon emissions.

Towards an Inclusive Urban Future

- The commission's recommendations also address **social inclusivity by advocating the establishment of health committees** to develop age-friendly neighborhoods and assess the needs of the elderly.
- Additionally, it calls for **improved healthcare access for migrants, proposing multilingual support services and extended public health facility hours.**

Prelims

Detention under NSA

Sub Topic: *Various Security forces and agencies and their mandate.*

Context:

The Punjab government is set to **extend the detention of Khadoor Sahib MP Amritpal Singh under the National Security Act (NSA) for another year,** a senior government official confirmed.

More on News

- Amritpal Singh **was initially detained under the NSA** along with several associates.
- On February 23, 2023, **thousands of Amritpal's supporters launched a violent attack on the Ajnala police station in Amritsar.**
- In response, the **Punjab Police launched a statewide manhunt forcing Amritpal to evade arrest for over a month.**
- In January 2025, the **Unlawful Activities (Prevention) Act (UAPA) was invoked against Amritpal Singh by Faridkot Police** in connection with the murder of Jaspreet Singh Hari Nau on October 10, 2024.

National Security Act (NSA), 1980

- It is a **preventive detention law** enacted by the Indian Parliament **to maintain public order and national security.**
- It **empowers the Central and State Governments to detain a person without formal charges for up to 12 months** to prevent them from acting in any manner prejudicial to:
  - The security of India
  - Relations with foreign countries
  - Maintenance of public order
  - Maintenance of supplies and services essential to the community
- The act **also allows detention of foreigners** to regulate their presence or expel them from India.

Historical Context

- The NSA is rooted in colonial-era preventive detention laws such as the **Bengal Regulation III (1818) and the Rowlatt Act (1919).**
- It followed the **Maintenance of Internal Security Act (MISA)** of 1971, which was repealed in 1977.
- The NSA was **enacted in 1980 during Indira Gandhi's government** as a successor preventive detention law.

Key Features

- **Preventive Detention:** The NSA is designed to detain individuals to prevent future crimes or threats rather than punish past offenses.
- **Authority:** Both **Central and State Governments** have the power to issue detention orders based on their subjective satisfaction that detention is necessary.

Constitutional Provisions

Article 22(3)(b) of the Indian Constitution permits preventive detention for reasons of state security and public order.

Article 22(4) limits detention without advisory board approval to three months, but the NSA allows detention up to 12 months with advisory board sanction.

- **Detention Period:** Initial detention can last up to **12 months.** The **period can be extended if fresh evidence emerges.**
- **Disclosure of Grounds:** The detained person **must be informed of the grounds of detention within 5 days,** extendable to 15 days under exceptional circumstances.
- **Advisory Board:** Within **three weeks of detention,** an Advisory Board (usually comprising High Court judges) **reviews the detention order.** If the Board finds sufficient cause, detention continues; otherwise, the detainee is released.
- **No Trial or Charges During Detention:** The detainee cannot be charged or tried during the detention period, and legal representation is limited during advisory board proceedings.

Unlawful Activities (Prevention) Act (UAPA), 1967

- It is a **comprehensive anti-terror law** enacted by the Indian Parliament to prevent unlawful activities and terrorist acts that threaten the **sovereignty, integrity, and security of India.**
- It aims to provide **effective legal measures to deal with individuals and associations** involved in unlawful activities, including terrorism.

Key Features

- **Scope and Purpose:** The Act targets **unlawful activities by individuals or associations** that seek to disrupt the sovereignty and territorial integrity of India, promote secession, or cause disaffection against the country. It also **addresses terrorist acts and organisations involved in terrorism.**
- **Unlawful Associations and Terrorist Organisations:** The Act empowers the government to declare certain associations unlawful if they engage in or support unlawful activities. It also allows the designation of terrorist organisations listed in its schedules, making membership or support to such organisations punishable.
- **Designation of Individuals as Terrorists:** A significant amendment in 2019 empowered the Central Government to **designate not only organisations but also individuals as terrorists under the Act**.
- **Punishments:** The Act prescribes stringent penalties for a range of offenses including membership in unlawful or terrorist organisations, raising funds for terrorism, organising terrorist camps, recruiting for terrorism, harboring terrorists, and conspiracy related to terrorism.

Special Powers for Investigation and Seizure:

- The Act grants special powers to investigating agencies like the **National Investigation Agency (NIA).**
- **Tribunal and Procedure:** The Act provides for the constitution of a **Tribunal headed by a High Court judge to adjudicate on the declaration of associations as unlawful.**
- **Forfeiture of Property:** The Act includes provisions for the forfeiture of proceeds of terrorism or properties intended to be used for terrorism.

Panchayat Advancement Index and Localisation of SDGs in India

Sub Topic: *Functions and responsibilities of the Union and the States, issues and challenges pertaining to the federal structure, devolution of powers and finances up to local levels and challenges therein.*

Context:

Recently, in a significant stride towards **evidence-based rural development,** the Ministry of Panchayati Raj launched the **Panchayat Advancement Index (PAI)**.

- The index aligns grassroots governance with the global **Sustainable Development Goals (SDGs)** framework by ranking over **2.16 lakh gram panchayats** on their progress across nine SDG-linked themes.

Why the Panchayat Advancement Index Was Introduced

- India has committed to the 2030 Agenda through the **UN's SDG framework** comprising **17 goals, 169 targets, and 231 indicators**.

- While NITI Aayog's **SDG India Index (2018)** tracks state-level progress, **localisation of SDGs (LSDGs)** is essential for impact.

The PAI was developed to:

- Translate national commitments into local action.
- Track SDG progress at the panchayat level.
- Empower grassroots governance through data-driven planning.
- Promote decentralised, participatory, and accountable development.
- As Sanyukta Samaddar, ex-SDG advisor to NITI Aayog, noted, the PAI represents the **"logical fruition"** of India's decentralised SDG monitoring model.

Structure and Methodology

- **Themes of Assessment**
  - PAI evaluates panchayats across **nine LSDG-aligned themes**:
  - Poverty-Free and Enhanced Livelihoods
  - Healthy Panchayat
  - Child-Friendly Panchayat
  - Water-Sufficient Panchayat
  - Clean and Green Panchayat
  - Panchayat with Self-Sufficient Infrastructure
  - Socially Just and Socially Secured Panchayat
  - Panchayat with Good Governance
  - Women-Friendly Panchayat
- **Indicators and Scoring**
  - **435 indicators** (331 mandatory, 104 optional) covering **566 data points**.
  - Scored on a **0–100 scale**.
  - Classified into five performance categories:
    - **Achiever (90–100)**
    - **Front Runner (75–90)**
    - **Performer (60–75)**
    - **Aspirant (40–60)**
    - **Beginner (<40)**
- **Coverage and Data Validation**
  - **2,16,285 gram panchayats** across **29 States/UTs** submitted validated data.
  - **11,712 panchayats** from **Meghalaya, Nagaland, Goa, Puducherry, and West Bengal** were excluded due to pending data validation.
  - **Uttar Pradesh**, with over 57,000 panchayats, submitted data for only 23,207, reflecting systemic data gaps.

Key Findings and Rankings

- **Overall Performance (2022–23 Baseline)**
- **Front Runners (699 panchayats)**: 0.3%
- **Performers (77,298 panchayats)**: 35.8%
- **Aspirants (1,32,392 panchayats)**: 61.2%
- **Beginners (5,896 panchayats)**: 2.7%
- **No panchayat** qualified as an **Achiever**.

Top Performing States

- **Gujarat**: 346 Front Runners | 13,781 Performers
- **Telangana**: 270 Front Runners | 10,099 Performers
- **Tripura**: 42 Front Runners
- States like **Bihar, Chhattisgarh**, and **Andhra Pradesh** had a high proportion of **Aspirant panchayats**, indicating developmental gaps.

Significance of PAI

- **Empowers panchayats** to assess and address local development needs.
- **Facilitates evidence-based planning**, resource allocation, and policy formulation.
- Encourages **healthy competition** among panchayats.
- Promotes **transparency, accountability**, and **participatory governance**.
- Aligns **rural schemes with SDG targets**, fostering coherence in national and local priorities.

Challenges in Implementation

- **Incomplete data submission** weakens national-level comparability.
- **Validation issues** in states like UP and West Bengal reflect administrative bottlenecks.
- **Capacity deficits** at the panchayat level, especially in underserved areas, hinder informed planning and implementation.
- **Limited digital literacy** and infrastructural gaps affect data quality and usage.

Section 69 of Bharatiya Nyaya Sanhita

Sub Topic: *Parliament and State legislatures—structure, functioning, conduct of business, powers & privileges and issues arising out of these.*

Context:

The introduction of Section 69 under the Bharatiya Nyaya Sanhita (BNS), 2023, **addressing sexual intercourse on the false promise of marriage,** has **reignited legal and constitutional debates across India.**

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- While the provision **aims to address the misuse of consent under deceitful conditions,** legal experts argue that it **undermines both judicial precedent and the established legal framework under the Indian Penal Code (IPC).**

False Promise of Marriage Cases: A Legal Grey Area

- Over the years, rape cases registered based on a false promise of marriage have often **courted controversy.**
- Critics argue that such provisions **risk misrepresenting consensual relationships,** where women willingly enter into physical relationships, later accusing their partners of rape.
- **Section 69 of the BNS specifically criminalises sexual intercourse conducted through deceit,** including a false promise of marriage.
- However, this provision **reduces the punishment compared to Section 63 of the BNS (which corresponds to Section 375 of the IPC),** effectively creating a lesser offence under similar circumstances.
- Legal analysts highlight that **this approach may not only duplicate existing legal remedies but also introduce confusion regarding the scope and severity of such cases.**

How Indian Courts Have Addressed the Issue

- India's Supreme Court has, through various rulings, already narrowed the applicability of rape charges in such scenarios:
- **Distinguishing Deceit from Broken Promises:** In ***Anurag Soni vs State of Chhattisgarh (2019)***, the Supreme Court clarified that a **breach of promise does not equate to rape unless the accused never intended to fulfill the promise from the outset.**
- ***Long-Term Consensual Relationships:*** In ***Rajnish Singh @ Soni vs State of U.P. (2025)***, the Court quashed the FIR where the complainant was in a consensual relationship for 15 years.
- The Court emphasised that **if consent was given without deception and based on mutual affection, it cannot be retrospectively labeled as rape.**
- **Pre-existing Marriages and Misconception of Fact:** In ***Abhishek Arjariya vs State of Madhya Pradesh (2025)***, the High Court ruled that **if the complainant was already married, alleging rape based on a promise of marriage does not qualify as consent obtained through misconception.**

Section 69: Redundancy and Constitutional Concerns

- Section 69 states that anyone who uses deceitful means, including a false promise of marriage, to engage in sexual intercourse—not amounting to rape—shall face **imprisonment of up to 10 years and a fine.**
- The **explanation expands deceit to include false promises of employment or marriage by concealing one's identity.**
- However, the **definition of consent** under Section 28 of the BNS—which mirrors Section 90 of the IPC—**already states that consent obtained under a "misconception of fact" is invalid.**
- If sexual intercourse under a false promise of marriage qualifies as rape under Section 63, creating a separate offence under Section 69 dilutes the gravity of the crime.
- Critically, **Section 69 lacks a non-obstante clause,** which would give it precedence over existing laws.
- Without this, and in the absence of a specific exclusion in Section 63, Section 69 **could be rendered unconstitutional under Article 14** for creating an arbitrary and unequal classification.

Need for Judicial Prudence and Police Discretion

- Legal experts advocate for a **more cautious approach.**
- **Courts are increasingly quashing such FIRs where no prima facie case of rape is made.**
- Hence, **law enforcement should conduct preliminary inquiries** to ascertain the validity of the complaint before filing charges.
- This would help prevent the misuse of legal provisions, reduce undue harassment of the accused, and ease the burden on the judiciary.

Mains

India's Heavy Industries and Engineering Sector

Sub Topic: *Planning, Mobilisation of resources, Growth, Development and Employment.*

Context:

The heavy engineering and machine tools sector, categorised under the capital goods industry, is receiving considerable attention in India due to its critical role in driving industrial expansion and economic progress.

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- This sector includes **essential industries** such as electrical equipment, machinery, and construction, all of which are fundamental to infrastructure development.
- According to the **Indian Electrical and Electronics Manufacturers' Association (IEEMA),** the **electrical equipment industry has experienced consistent double-digit growth,** particularly in power equipment such as transmission systems and transformers, fueled by domestic demand and global market expansion.
- Additionally, **India ranks as the third-largest market for construction equipment, highlighting the sector's importance in national development.**

Government Initiatives and Policy Support

- **Strengthening Domestic Production:** The **Ministry of Heavy Industries** has introduced multiple policies aimed at strengthening domestic production **while reducing reliance on imports.**
- **Make in India:** These initiatives **align with the broader Make in India campaign** launched in 2014, which aims to bolster the manufacturing sector's contribution to GDP, create employment opportunities, and enhance technological capabilities.

Overview of the Heavy Industries and Engineering Sector

- **Capital Goods Sector:** The **capital goods sector currently contributes approximately 1.9% of India's GDP.**
  - The heavy engineering and machine tool sector comprises several sub-industries, including dies, molds, press tools, plastic machinery, earthmoving and mining machinery, metallurgical machinery, textile machinery, process plant equipment, printing machinery, and food processing machinery.
  - Due to government intervention, production in this sector increased significantly from Rs. 2,29,533 crore in 2014-15 to Rs. 4,29,001 crore in 2023-24.
- **Policy Framework:** The **policy framework for this sector includes** several business-friendly measures, such as:
  - **No requirement for an industrial license.**
  - **100% FDI permitted** through the automatic route, except for countries sharing land borders with India.
  - **Unrestricted quantum of payments for technology transfer,** royalty, and design acquisition.
  - **No restrictions on imports and exports.**
- **Budget 2025-26:** Additionally, the **Union Budget 2025-26 proposes to exempt 35 additional capital goods for EV battery manufacturing and 28 for mobile phone battery production, aiming to promote domestic lithium-ion battery production.**

National Capital Goods Policy (2016)

- Formulated by the **Ministry of Heavy Industries & Public Enterprises,** the National Capital Goods Policy **aims to increase the capital goods sector's share in manufacturing from 12% in 2016 to 20% by 2025.**
- The policy envisions positioning **India as a leading capital goods producer** by doubling production and expanding exports to at least 40% of total output.

- It also aims to **advance technology within the sector from basic and intermediate levels to more sophisticated levels.**
- **Key features of the policy include:**
  - Increased budgetary allocations for competitiveness enhancement.
  - Launch of a Technology Development Fund under the PPP model.
  - Establishment of regional Centers of Excellence for skill development.
  - Modernisation of existing manufacturing units, particularly SMEs.
  - Development and upgrade of testing and certification infrastructure.

Capital Goods Sector Development: Phase I & II

- **Phase I:** Launched in November **2014** with an outlay of Rs. 995.96 crore, Phase I **fostered industry-academia partnerships** to develop technology solutions and industrial infrastructure. Major achievements include:
  - Establishment of **8 Centers of Excellence (CoEs),** leading to the development of 30 indigenous technologies.
  - Setup o**f 15 Common Engineering Facility Centers (CEFCs)** and 6 Web-Based Technology Innovation Platforms.
  - Implementation of a **Technology Acquisition Fund Programme (TAFP),** leading to five significant technology acquisitions.
  - Development of an exclusive **Integrated Machine Tools Park** in Tumakuru, Karnataka, spanning 530 acres.
- **Phase II:** Launched in January **2022**, Phase II aims to expand the impact of Phase I with an outlay of Rs. 1207 crore, including Rs. 975 crore in budgetary support and Rs. 232 crore in industry contributions. Under Phase II:
  - 9 new **Advanced Centers of Excellence** have been sanctioned.
  - 5 new CEFCs have been approved.
  - 3 projects focused on skill development have been initiated.
  - 7 projects for testing and certification centers have been approved.
  - 8 Industry Accelerator projects for indigenous technology development have been sanctioned.
  - **Technology Innovation Portals** are being strengthened to drive industrial research.

Recent Milestones in the Capital Goods Sector

- **SITARC,** Coimbatore, developed a 6-inch BLDC submersible pump, reducing import dependency by 80%.
- **CMTI** launched a high-speed rapier loom machine at ITMA 2023 in Milan.
- **Toyota Engine Manufacturing** implemented Industrial Internet of Things (IIOT) technology for predictive maintenance.
- **ARAI,** Pune, established India's first battery testing facility under the Ministry of Heavy Industries.
- **IISc Bengaluru** developed 6 smart technologies and 5 smart tools, including advancements in digital twin, virtual reality, and robotics.
- **BHEL** set up multiple Centres of Excellence and is developing testing facilities for naval, aircraft, and industrial applications.

Green Logistics at Ports: A Sustainable Future for Maritime Transport

Sub Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

India is **actively promoting green logistics** by installing **EV charging stations at ports** under the **PM E-drive scheme** and investing in **electric mobility** for port operations. Green logistics is a crucial strategy to **reduce environmental impact** while ensuring **operational efficiency** in the transportation sector.

Green Logistics: Concept and Significance

- Green logistics involves the adoption of **eco-friendly technologies and practices** across the entire supply chain.
- It aims to **reduce carbon emissions, optimise resource use, and improve efficiency** in logistics operations.
- It covers **transportation, storage, distribution, and reverse logistics** to ensure minimal environmental impact.
- Key technologies include **electric vehicles, digital tracking, blockchain systems, and renewable energy integration**.

Expanding Green Infrastructure at Ports

- The government is also focusing on **port expansion** with an emphasis on sustainability.
- Development of **Vadhawan Port in Maharashtra** is underway, with an estimated cost of **₹76,220 crore** and a **cargo handling capacity of 300 MMT**.
- **Roadway decongestion initiatives** include the construction of a **six-lane highway** connecting the **Jawaharlal Nehru Port Trust (JNPT)** to the hinterland.
- Electrification of port operations contributes to India's **net-zero emissions goal by 2070**.

India's Green Logistics Initiatives at Ports

- The **Union Heavy Industries Ministry** has collaborated with the **Ministry of Ports, Shipping, and Waterways** to install **EV charging stations** at ports.
- This is part of the **₹10,900-crore PM E-drive scheme**, with **₹2,000 crore allocated** for **EV charging infrastructure**.
- **₹1,500 crore is allocated** for subsidising **electric trucks**, recognising them as a **sunrise sector**.
- Electrification of **trucks, forklifts, and tugs** used in port operations is essential to reduce emissions and dependence on fossil fuels.

Global Examples of Green Logistics in Ports

- **IMO 2020 regulations** mandated a **reduction of sulfur emissions** from ships from **3.5% to 0.5%**.
- Countries like **Denmark and Norway** are working towards **zero-emission fleets by 2050** using **biofuels and LNG**.
- The **Zero Emission Services consortium** in Europe is developing **battery-powered barges** to eliminate fossil fuel use in inland waterways.

Vietnam's Green Port Model

- Vietnam is emerging as a leader in **green port development**, aligning with its **net-zero commitment by 2050**.
- Government policies like **Decision No. 888/QD-TTg and 710/QD-CHHVN** provide a roadmap for **mandatory green port compliance by 2030**.
- Ports like **Tan Cang Cat Lai and Long An International Port** have adopted **electric cargo handling equipment, digital tracking, and renewable energy solutions**.
- **Cai Mep International Terminal (CMIT)** has committed to **The Climate Pledge**, aiming for **net-zero emissions by 2040**.

- **Tesla has announced electric container barges**, starting with operations in **Rotterdam, Amsterdam, and Antwerp**.
- Several ports have adopted **cold ironing**, where ships **switch off generators** and use **shore electricity** to reduce emissions.

Challenges in Implementing Green Logistics

- **High initial costs** for infrastructure and renewable energy solutions.
- **Lack of awareness and technical expertise** among port managers.
- **Need for stronger policy enforcement** and **green financing mechanisms**.
- **Limited adoption of digital and AI-driven logistics solutions**.
- **Dependence on fossil fuels in many regions**, requiring phased transition strategies.

Way Forward: Strengthening Green Logistics in India

- **Public-private partnerships (PPP)** to drive investments in green port infrastructure.
- **Stronger incentives** for electric mobility in port operations.
- **Research and development** in renewable energy solutions for ports.
- **Integration of AI, IoT, and blockchain** for efficient logistics management.
- **Expansion of waterway transport** to reduce road congestion and emissions.

ONDC to Help Digital Commerce Grow Fivefold by 2030

Sub Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

A recent McKinsey & Company study has projected that the value of digital commerce in India will rise significantly, reaching an estimated **$320-340 billion by 2030**.

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This marks a fivefold increase from **$60-70 billion in 2022**, with the growth largely driven by the **Open Network for Digital Commerce (ONDC)** — a government-backed platform that connects buyers and sellers online.

Key Projections for Digital Commerce Growth

- **Overall Digital Commerce Value**: Expected to grow from **$60-70 billion** in 2022 to **$320-340 billion** by 2030. The increase is driven by the ONDC platform and growing digital penetration.
- **Sector-Specific Growth Projections**:
  - **Fashion and Lifestyle**: Projected to rise from **$11-13 billion** in 2022 to **$80-82 billion** in 2030.
  - **Electronics and Durables**: Expected to grow **three times**, from **$24-26 billion** in 2022 to **$70-72 billion** in 2030.
  - **Grocery Sector**: Expected to grow **11 times**, from **$4-5 billion** in 2022 to **$50-55 billion** in 2030.
  - These three categories are anticipated to account for **62%** of total digital commerce in India by 2030.
- **Growth in Services Sectors**:
  - **Food and Beverages**: Projected to grow **five-six times**, reaching **$30-32 billion** by 2030.

- **Entertainment (Gaming, OTT Services, Films, TV)**: Expected to grow **six times**, hitting **$17-19 billion** by 2030.
- **Hospitality**: Digital consumption is expected to grow **2.5 times** between 2022 and 2030.
- **Pharmaceuticals**: Projected to grow **eight to ten times**.
- **Books and General Merchandise**: Expected to grow **six to seven times**.

Factors Driving Growth

- **Digital Economy**: The expansion of India's vibrant digital economy is a key driver for the projected growth across sectors.
- **Smartphone Penetration**: India's number of smartphones crossed **1 billion** in 2024, significantly boosting digital engagement.
- **Internet User Growth**: The number of Internet users is expected to surpass **900 million** by 2025, expanding the digital market further.
- **Global E-Commerce Influence**: India's digitally connected consumers made up **40%** of global internet transactions.
- **Business Hub Appeal**: Between 2021 and 2023, **984 international companies** registered to operate in India, compared to **320** in the previous two years.
- **Global Capability Centres**: India is home to over **1,500 global capability centres**, with **250** added in the past three to five years.
- **Demographic Advantage**: India, with a population of **1.4 billion** (surpassing China), presents a massive consumer base for digital commerce.
- **Rising Spending Power**: The average spending power of Indians increased from **$271** in 2012 to **$705** in 2023, expanding the potential market for goods and services.
- **Pro-Business Government Approach**: India's government has developed a more pro-business stance, along with historically low labour costs, making it an attractive business hub.
- **STEM Talent**: India is home to **one-third** of the world's science, technology, engineering, and mathematics (STEM) graduates, further boosting its appeal as a digital commerce hub.

Challenges and Cautions

- **Financial Inequality**: Despite the rise in spending power, **95% of consumers** in India have financial assets of less than **$2,000**, making high-end products out of reach for many.
- **Long Payoff Periods**: Companies in India often face long wait times for payoffs as it takes time to build operations and overcome market challenges.
- **Dependence on Government Spending**: The study pointed out an over-dependence on government spending, especially in the past five years, which could impact the sustainability of growth.

Open Network for Digital Commerce (ONDC)

- A **government-backed initiative** aimed at **democratising e-commerce** in India.
- Launched in **April 2022**, by the **Department for Promotion of Industry and Internal Trade (DPIIT)** under the Ministry of Commerce.
- It seeks to **break the dominance of large e-commerce platforms** by enabling **interoperability** across networks.
- ONDC is incorporated as a **non-profit Section 8 company,** with founding support from the **Quality Council of India** and **Protean eGov Technologies Limited.**
- **Key Features:**
  - **Open Protocols:** ONDC is based on **open-source methodology**, allowing **buyers and sellers from different platforms** to transact seamlessly.
  - **Inclusivity:** It empowers **small businesses, retailers, and local artisans** to access the digital marketplace.
  - **Decentralised Architecture:** Unlike traditional platforms, ONDC does **not own or operate e-commerce services** but acts as an **enabler for interconnectivity**.
  - **Market Expansion:** It aims to **bridge regional and linguistic gaps**, bringing **untapped markets** into the fold of digital commerce.
  - **Cost Efficiency:** ONDC lowers the **cost of customer acquisition** and **transaction processing** for sellers.

Inter-Ministerial Panel to Monitor Potential Import Surge Amid U.S. Tariff Hikes

Sub Topic: *Effects of liberalisation on the economy, changes in industrial policy and their effects on industrial growth.*

Context:

Amid growing concerns over potential diversion of global trade flows, the Indian government has established an inter-ministerial panel to monitor imports entering the country, particularly from neighbours such as China, Vietnam, Thailand, and Indonesia.

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- The move comes **in response to the United States' decision to impose significantly higher reciprocal tariffs** on these countries, which could prompt exporters to redirect their shipments to India.
- The newly formed **panel will comprise officials from the Ministry of Commerce and Industry, Ministry of Finance, and relevant line ministries** depending on the product categories.
- Its mandate is **to track import patterns, detect any abnormal surges, and recommend countermeasures if necessary.**

US and Reciprocal Tariffs and India

- The U.S. administration recently announced that **reciprocal tariffs would be imposed on 60 countries with which it has major trade deficits.**
  - These tariffs, set to take effect from April 9, include a **34% duty on imports from China, 46% on Vietnam, 32% on Indonesia, and 36% on Thailand** — all significantly higher than **India's prevailing import duty of 26%.**
- According to a government official, **India must remain vigilant in the coming months to avoid becoming a dumping ground for goods** redirected from these high-tariff countries.
  - "While feedback from export promotion councils and industry stakeholders has traditionally guided policy, the evolving global trade environment necessitates proactive government surveillance," the official said.
- India already has a robust **anti-dumping framework in place**, with the **Directorate General of Trade Remedies (DGTR)** playing a key role in ensuring that unfair trade practices are addressed.
  - However, the new panel is expected to strengthen this framework by responding in real-time to emerging risks from trade diversion.
- The government also maintains that **any protective action it takes will remain compliant with World Trade Organisation (WTO) norms.**
- A report by **CareEdge** has identified **key sectors that may experience an increase in diverted imports from the U.S. to India.**
  - These include **consumer goods, electronics, chemicals, and steel — all industries with high exposure to global supply chains.**

As global trade dynamics shift rapidly, India is preparing to safeguard its domestic markets while ensuring it remains aligned with international trade obligations. The government's proactive move reflects its intent to protect local industries from potential market distortions caused by tariff-led trade re-routing.

Global Trade Forecast for 2025

Sub Topic: *Effects of liberalisation on the economy, changes in industrial policy and their effects on industrial growth.*

Context:

In a significant revision to its earlier projections, the **World Trade Organisation (WTO) has forecast a 0.2% contraction in global merchandise trade for calendar year 2025.**

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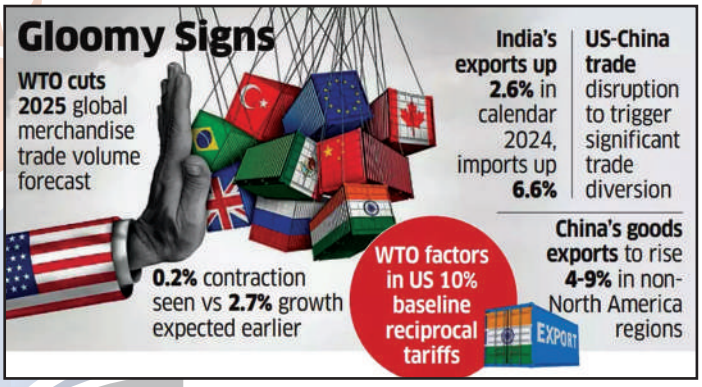
- This marks a nearly **three-percentage-point downgrade from its previous estimate of 2.7%** growth, highlighting growing **concerns over escalating trade tensions and economic uncertainty.**



- If the **protectionist trends**—spurred by US President Donald Trump's renewed tariff policies—**intensify, the WTO warned the contraction could deepen to 1.5%.**
- The forecast revision reflects a **sharp departure from the relatively optimistic outlook issued in October 2024.**

World Trade Organisation (WTO)

The World Trade Organisation (WTO) is the **only global international organisation that deals with the rules of trade between nations,** aiming to ensure that trade flows as smoothly, predictably, and freely as possible. Established on January 1, 1995, as the **successor to the General Agreement on Tariffs and Trade (GATT).** It has **166 members representing over 98% of global trade and GDP,** including countries and entities like the European Union, Hong Kong, and Taiwan. It is headquartered in **Geneva, Switzerland.** The top decision-making body, comprising all member countries, meets usually every two years. The General Council handles day-to-day operations and meets regularly in Geneva.

North America to Face Steep Declines in Trade

- According to the WTO, **North America is likely to bear the brunt of the trade downturn,** with **exports forecast to plunge by 12.6% and imports by 9.6% in 2025.**

- The WTO cautioned that **least-developed and export-dependent countries will be especially vulnerable** to the ripple effects of retaliatory tariffs and supply chain disruptions.

Simulations Highlight the Impact of Policy Uncertainty

- WTO economists emphasised that the **surge in protectionist measures and the rising unpredictability of trade policy could significantly depress trade activity.**
- If fully implemented, **Trump's reciprocal tariffs alone could shave 0.6 percentage points off global trade growth in 2025.**
- **Policy uncertainty could add another 0.8 percentage point decline**, resulting in a total contraction of 1.5%.

Services Trade Rises, But May Not Offset Goods Decline

- Although merchandise trade faces headwinds, **global services trade continued its upward trajectory in 2024, expanding 9% to $8.69 trillion.**
- **Services now make up 26.4% of global trade**—the highest share since 2005—driven by digital transformation and increased demand in sectors like IT, finance, and professional services.
- However, the WTO noted that **these figures do not yet fully capture the potential knock-on effects of goods trade disruptions** spilling over into services, particularly in logistics, tourism, and cross-border digital commerce.

UNCTAD Predicts Global Growth Slowdown Below Recession Threshold

- Adding to the grim outlook, the **United Nations Conference on Trade and Development (UNCTAD)** warned that **global GDP growth is expected to slow to 2.3% in 2025, falling below the 2.5% threshold that typically signals a global recession.**
- **In 2024, the world economy grew by 2.8%,** but growth is projected to decelerate across key markets: **India's expansion is expected to ease from 6.9% to 6.5%, China's from 5% to 4.4%,** and the US from 2.8% to just 1%.
  - The European Union is projected to see a modest increase from 0.9% to 1%.

50 Years of Microfinance in India

Sub Topic: *Inclusive growth and issues arising from it, role of NGOs, SHGs, various groups and associations, donors, charities, institutional and other stakeholders.*

Context:

Microfinance in India, **pioneered by SEWA Bank in 1974,** has **evolved into a ₹4.2 lakh crore industry, serving 8 crore borrowers.**

Microfinance refers to a range of financial services including small loans, savings, insurance, and financial education aimed at low-income individuals or groups who lack access to traditional banking services.

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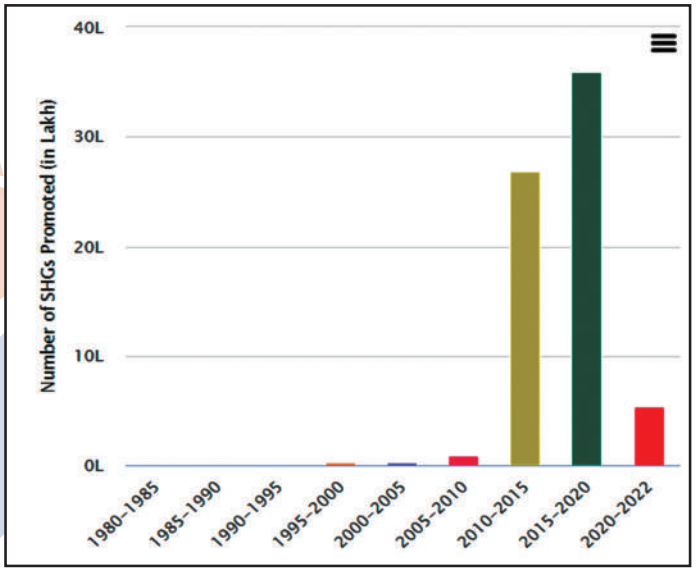
- Initially focused on poverty alleviation, it now plays a **crucial role in financial inclusion, especially for women and rural entrepreneurs.**
- However, **challenges like geographical concentration, over-indebtedness, and regulatory hurdles persist.**



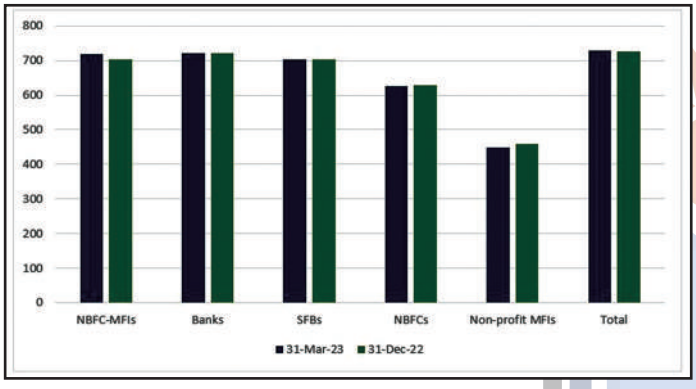
Evolution of Microfinance in India

- **Phase 1: Traditional Microfinance (1974-1990)**
  - **SEWA Bank** introduced doorstep banking, credit cooperatives, and financial literacy for women.
  - Government schemes like **Integrated Rural Development Programme (IRDP)** and **Regional Rural Banks (RRBs)** aimed at rural credit but faced high defaults.
  - **Subsidised credit failed, leading to a shift toward sustainable models.**
- **Phase 2: Market-Driven Reforms (1991-1999)**
  - **NABARD's SHG-Bank Linkage Program (1992)** boosted repayment rates.
  - **Private MFIs emerged,** proving the poor were creditworthy.
  - **Sa-Dhan (1999) became the first MFI network, promoting best practices.**
- **Phase 3: Rapid Growth & Crisis (2000-2012)**
  - **Commercial banks began funding MFIs,** leading to rapid expansion.

- **Andhra Pradesh crisis (2010):** Coercive recovery practices triggered suicides and defaults, prompting strict RBI regulations (Malegam Committee).
- **MFIs transformed into NBFCs,** attracting private equity but facing **"mission drift"**—prioritising profits over social impact.

❖ **Phase 4: Digital & Regulatory Maturity (Post-2012)**

- **RBI harmonised microfinance rules (2022),** ensuring transparent lending and borrower protection.
- **Bandhan Bank (2015)** and **Small Finance Banks (SFBs) formalised microfinance.**
- **COVID-19 disruptions** led to digital adoption but also loan defaults.



❖ **Current Landscape (2024)**

- **₹5.4 lakh crore in active loans, covering 730 districts.**
- **Top 5 states** (Bengaluru, Tamil Nadu, West Bengal, Karnataka, Maharashtra) hold 55% of loans—showing geographical skew.
- **Sustainability focus:** Green loans, water-sanitation projects, and health micro-insurance are growing.

Key Challenges

❖ **Over-Indebtedness:** Multiple loans to same borrowers increase default risks.

❖ **Limited Financial Literacy:** Many borrowers don't understand loan terms.

❖ **Regulatory Gaps:** Need better integration of SHGs, NBFCs, and credit bureaus.

❖ **Climate Risks:** MFIs lack products for climate-vulnerable regions (e.g., flood-prone areas).

Way Forward

❖ **Expand Digital Lending:** Mobile banking can improve rural reach.

❖ **Strengthen Credit Bureaus:** Prevent over-lending with real-time data.

❖ **Gender-Centric Policies:** More loans for women-led enterprises.

❖ **Climate-Adaptive Finance:** Insurance-linked loans for farmers in disaster-prone zones.

Pradhan Mantri Mudra Yojana: A Decade of Empowering the Unfunded

Sub Topic: *Indian Economy and issues relating to planning, mobilisation of resources, growth, development and employment. Inclusive growth and issues arising from it.*

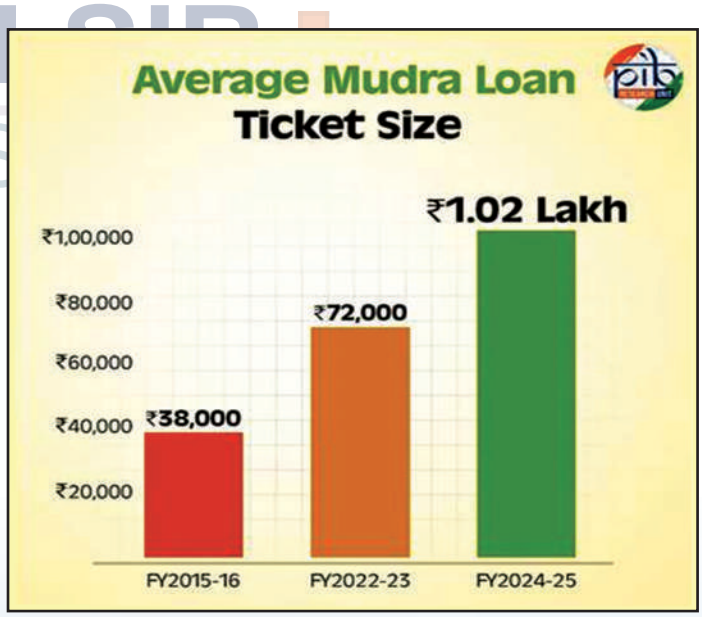
Context:

Pradhan Mantri Mudra Yojana (PMMY) which was launched on **April 8, 2015**, **has completed one decade.** It aimed to democratise credit by **"funding the unfunded"** — providing **collateral-free loans** to micro and small entrepreneurs traditionally outside the ambit of formal finance. A decade on, the scheme has become a cornerstone of **financial inclusion, grassroots entrepreneurship**, and **social equity** in India.

Key Achievements Over 10 Years

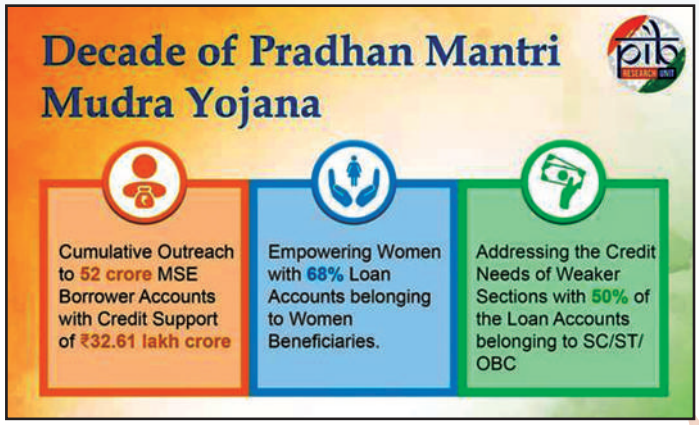
❖ **Massive Outreach and Disbursal:**

- Over **520 million loans** worth **₹33.65 trillion** sanctioned (₹32.87 trillion disbursed).
- About **100 million first-time borrowers**, highlighting the scheme's **transformative outreach**.



- Loans are disbursed under 4 categories: **Shishu (up to ₹50,000)**, **Kishore (₹50,000–₹5 lakh)**, **Tarun (₹5–10 lakh)**, and **Tarun Plus (₹10–20 lakh)** introduced in 2024.

- **Credit Deepening & Maturity:**
  - Shift from **Shishu (92% in 2015)** to **Kishore and Tarun (now 37%)**, indicating credit maturation.



  - **Average ticket size** increased from ₹40,000 in FY16 to ₹1.5 lakh in FY25.
  - **Sanction-to-disbursal efficiency** improved: 25.41 lakh crore sanctioned vs 25.32 lakh crore disbursed in FY24.
- **Improved Loan Performance:**
  - **Non-Performing Assets (NPAs)** have declined from **4.77% in FY21** to **3.4% in FY24**, showing responsible credit behaviour.
  - Gross NPA in FY25 stood at **2.21%**, outperforming many other credit segments.

Social Inclusion and Regional Spread

- **Women Empowerment:**
  - **68% of loans** (₹13.8 trillion across 348 million accounts) and **44% of disbursed amount** went to **women entrepreneurs**.
  - Women's economic empowerment has led to improved household stability and job creation.
- **Marginalised Communities:**
  - 50% of beneficiaries are from **SC/ST/OBC** backgrounds.
  - Substantial outreach to minorities (11%) reinforces **inclusive growth**.

Difference Between Mudra Loan and Credit Card Loan:

Aspect	Mudra Loan	Credit Card Loan
Purpose	To promote **entrepreneurship** and **self-employment**	To support **personal consumption** and short-term liquidity
Type of Growth Promoted	**Capital investment-led growth**	**Consumption-led growth**
Usage Pattern	For buying machinery, expanding business, working capital etc.	Shopping, travel, emergency expenses, lifestyle purchases
Economic Impact	**Generates employment, promotes MSME sector**, boosts production	**Drives demand in retail, services, and consumption sectors**

State and Regional Trends

- Leading states: **Tamil Nadu, Uttar Pradesh, Karnataka, West Bengal, Bihar, Maharashtra**.
- High per capita account penetration in **Tripura (86,320/1L people)**, **Karnataka**, and **Odisha**.
- Expansion even in remote Union Territories like **Jammu & Kashmir**, reflecting pan-India impact.

Human Stories Behind the Numbers

- Real-life success stories illustrate PMMY's transformative capacity:
- **Kerala**: A woman scaled a mat business 5x via a Shishu loan.
- **Punjab**: Kishore loan enabled a car service station.
- **Tamil Nadu**: A daily wage worker became an employer through a floor mill.
- These stories embody the scheme's motto: *trusting the smallest dreams*.

Impact on MSMEs and Employment:

- **MSME credit boom**: Lending surged from ₹8.51 lakh crore (FY14) to ₹27.25 lakh crore (FY24).
- PMMY accounts for a significant rise in **employment generation**—an estimated **25.2 million jobs/year** since inception (SKOCH, 2024).
- Shift in mindset: From job-seeking to **job-creating**, especially in rural and semi-urban areas.

Challenges & The Way Forward

- **Strengthening Support Ecosystem:** MLIs should provide **business advisory**, **market access**, **digital skilling**, and **formal registration assistance**.
- **Ensuring Scalability:** Structured interventions can help enterprises **graduate from subsistence to sustainable growth**.

- **Improved Financial Literacy:** Financial and digital literacy must be promoted to avoid misuse and improve repayment quality.
- **Better Data Analytics:** Real-time performance tracking of loan accounts can enhance **targeting and monitoring**.

World Bank Social Protection Report 2025

Sub Topic: *Inclusive growth and issues arising from it.*

Context:

The **World Bank's State of Social Protection Report 2025**, released on **April 7, 2025**, paints a concerning picture of global social protection, especially in low- and middle-income countries (LICs and MICs). The report underscores the **urgent need for targeted reforms** to ensure no one is left behind.

The Global Gap in Social Protection

- **Nearly 2 billion people** in LICs and MICs were **without adequate social protection** as of 2022.
  - Of these, **1.6 billion received no social protection at all**.
  - The rest lived in **poor households** with **limited benefits**, unable to escape poverty or cushion shocks like economic crises, climate change, or conflicts.

Country Income Classification and Social Protection Gaps

- **Low-Income Countries (LICs):** Over **80% of the population** lacks access or is inadequately covered. **On average 80% receive no assistance**; an additional **3% receive insufficient aid**.
- **Lower-Middle-Income Countries (LMICs):** Over **30% of individuals** lack adequate protection.
- **Upper-Middle-Income Countries (UMICs): 11%** are entirely excluded. **6%** receive inadequate support.
- **In absolute numbers**, the crisis is **worse in MICs**: **1.2 billion without help in MICs** vs. **500 million in LICs**.

Regional Breakdown

- **Sub-Saharan Africa:** Over **70% of the population** has **no access** to social protection. Only a **small fraction** receives limited aid.
- **Extreme Poverty and Social Protection: 88% of the global extreme poor** lacked adequate or any social protection.
  - **In LICs: 98%** of the extremely poor are unprotected.
  - **In Sub-Saharan Africa: 97%** lack protection.

Progress and Pace (2010–2022)

- **Progress Made:** Across 73 countries, **coverage increased from 41% to 51%**. Growth primarily in **social assistance** (cash transfers, school meals, food aid).
- **LICs saw the largest percentage gain**: Coverage among the poorest increased by **17 percentage points**.
- **Still Lagging**: **75% of people in LICs** and **58% in LMICs** receive **no social protection**.
  - **Social insurance** (pensions, health, unemployment): Covers just **2% in LICs** and **8% in LMICs**.

Future Outlook

- **If trends persist:**
  - **Full coverage for extreme poor**: **By 2043** (18 years).
  - **Poorest 20% with adequate protection**: **By 2045** (20 years).
- **2030 SDG Targets at Risk**: Achieving **substantial coverage of the poor and vulnerable** by 2030 is **unattainable without urgent acceleration**.

Climate Change & Fragile States

- **Climate Risk**: Could push **130 million more people into extreme poverty by 2030**. Most social protection systems are **unprepared** for climate-related shocks.
- **Fragile and Conflict-Affected States (mainly in Africa and Asia):** Will host **60% of the world's extreme poor by 2030**. Need **urgent emergency relief** + **long-term social protection strategies**.

Financial Disparities in Social Protection

- Countries currently spend **5.3% of GDP** on social protection, but there are significant disparities:
  - **High-income countries** spend **5.3 times** more as a share of GDP than LICs.
  - **Social insurance** takes up a disproportionate share of funding, often benefiting **formal sector workers** and retirees, while **social assistance** (more inclusive for the poor) receives a smaller share.
- LICs spend only **0.8% of GDP** on social assistance, while upper-middle-income countries spend around **2%**.

Barriers and Recommendations

- **Financing remains a key barrier** to expanding social protection systems in LICs and LMICs.
  - **International grants** fund up to **77%** of social assistance programs in fragile and conflict-affected states.
  - Redirecting **subsidies** (especially in fossil fuels and agriculture) towards **targeted support** for the poor could unlock additional resources.

- The report emphasises the need for **robust delivery mechanisms**, such as:
  - **Dynamic social registries**
  - **Digital payments**
  - **Integrated case management**
- These mechanisms should be **shock-responsive**, **climate-resilient**, and **digitally enabled** to ensure timely and inclusive support in times of crisis.

Prelims

'NITI NCAER States Economic Forum' Portal

Sub Topic: *Government Budgeting*

Context:

Union Finance Minister Nirmala Sitharaman is set to launch a new portal, developed by **NITI Aayog** and the **National Council of Applied Economic Research (NCAER)**, on **April 1, 2025**.

More on News

- The portal, titled the **'NITI NCAER States Economic Forum'**, will serve as a **comprehensive repository** for data on the **finances of States** in India.
- It will cover data spanning **30 years (1990-91 to 2022-23)**, focusing on various **social, economic, and fiscal parameters**.

Objective

The initiative is designed to address concerns about **resource allocation** and **discrimination** in the sharing of resources, offering transparent data that could be used to ensure better fiscal management and informed policymaking.

Components of the Portal

- **State Reports**: Summarises the macroeconomic and fiscal landscape of **28 Indian States**, covering indicators on **demography**, **economic structure**, and **socio-economic and fiscal aspects**.
- **Data Repository**: Provides access to a complete database categorised into five verticals: **demography**, **economic structure**, **fiscal**, **health**, and **education**.
- **State Fiscal and Economic Dashboard**: Features graphical representations of key economic variables for easier understanding.
- **Research and Commentary**: Includes extensive research on State finances and fiscal policy, offering insights into **financial management at both State and national levels**.

Key Benefits

- The portal will help in understanding **macroeconomic**, **fiscal**, **demographic**, and **socio-economic** trends across States.
- It will offer **easy access to data** in a **user-friendly format** and allow comparison of data between States and with national figures.
- The portal aims to **facilitate informed debates** and **discussions** for policymakers, researchers, and others interested in State finances.

e-NWR and e-KUN Platforms

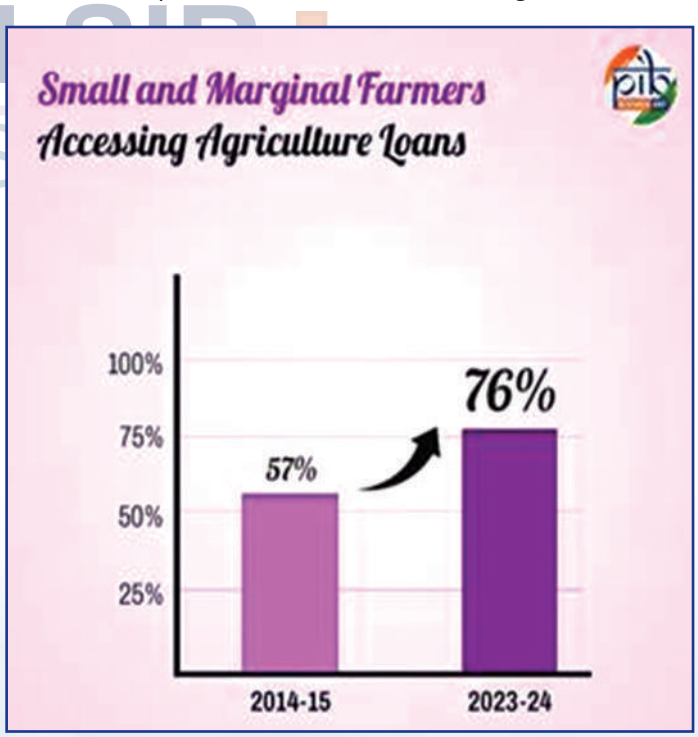
Sub Topic: *Issues related to direct and indirect farm subsidies and minimum support prices.*

Context:

In a major move to **enhance access to credit for farmers and agribusinesses,** the Union finance ministry has urged all banks — including public sector banks (PSBs), private banks, regional rural banks (RRBs), and cooperative banks — to **onboard the National Credit Guarantee Trustee Company (NCGTC) and the e-Kisan Upaj Nidhi (eKUN) portal.**

More on News

- These digital platforms are **designed to facilitate pledge-based financing through electronic negotiable warehouse receipts (e-NWRs)**, enabling farmers to use their stored agricultural produce as collateral for obtaining loans.



Electronic Negotiable Warehouse Receipt (e-NWR)

It is a **digital version of the traditional negotiable warehouse receipt** issued by registered warehouses regulated under the **Warehousing (Development and Regulation) Act, 2007** and governed by the **Warehousing Development and Regulatory Authority (WDRA) of India.** It is an **electronic document issued by WDRA-registered warehouses** that acknowledges the deposit of agricultural commodities or other goods. e-NWR **acts as a negotiable instrument,** meaning it can be transferred, endorsed, or traded without the physical movement of goods.

eKUN Platform

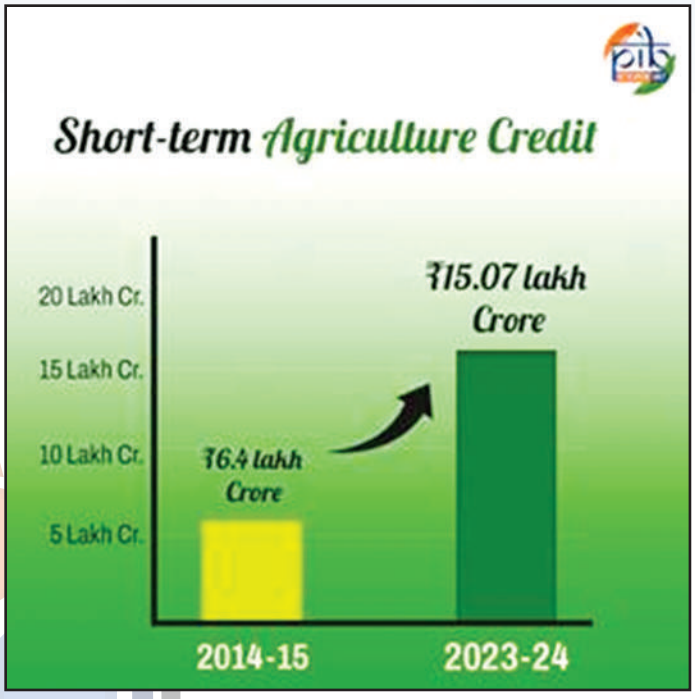
The eKUN platform is an emerging **digital initiative aimed at transforming agricultural credit systems in India by leveraging technology to facilitate easier**, transparent, and more efficient access to credit for farmers. While detailed official descriptions are limited, available sources indicate that **eKUN focuses on improving agricultural financing resilience and credit delivery through digital means.**

e-NWR: A Game Changer for Agri-Credit

- The e-NWR framework, **backed by the Warehousing Development and Regulatory Authority (WDRA)**, has gained traction among financial institutions.
- As of now, **eight banks have joined NCGTC**, while **26 banks have registered with the e-KUN portal,** which is integrated with the **government's JanSamarth Portal.**
- According to a senior government official, the ministry has instructed PSBs to ensure their sponsored RRBs formulate **dedicated loan policies for e-NWR financing** and urgently join both platforms to expand credit coverage in rural areas.
- To boost awareness, **banks have been advised to launch social media campaigns and branch-level outreach programs** to educate farmers about the benefits of loans against e-NWRs.

Credit Guarantee Scheme for e-NWR

- The credit guarantee scheme for loans against e-NWRs offers **protection against both credit and warehouseman risks.**
- The initiative aims to **incentivise lending institutions by mitigating risk exposure**, thereby encouraging them to extend credit to farmers and agri-enterprises.
- **Loans sanctioned** under this scheme **qualify as agricultural credit and fall under priority sector lending (PSL).**
- The Reserve Bank of India **(RBI) recently revised PSL limits for e-NWR-backed loans:**
  - **For individual farmers:** Limit raised from ₹75 lakh to ₹90 lakh
  - **For farmer producer organisations (FPOs), corporate farmers, and cooperatives:** Limit raised from ₹75 lakh to ₹4 crore



Suggestions from the Banking Sector

- A senior official from a **leading PSB recommended that credit guarantee fees be collected upfront at the time of disbursement,** rather than through monthly instalments.
  - This **aligns with existing practices under the Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE)** and would ease the administrative burden on banks.
- Another critical demand from banks is to **expand the number of WDRA-accredited warehouses,** which will improve the availability of storage facilities and enhance trust and accessibility for borrowers.
- Increasing WDRA-accredited godowns **will strengthen the entire ecosystem and make it more farmer-friendly**.

One State-One RRB Policy

Sub Topic: *Inclusive growth and issues arising from it.*

Context:

The **Ministry of Finance** has notified the **fourth phase of consolidation** of **Regional Rural Banks (RRBs)** to implement the **'One State-One RRB'** policy. A total of **26 RRBs** in **11 states and 1 Union Territory** will be **amalgamated into 11 new RRBs**. The total number of RRBs will be reduced from **43 to 28**, with **22,000+ branches** across **700 districts**.

Objectives of the Policy

- Enhance **operational efficiency** and **scale economies**.
- **Rationalise costs** and reduce redundancy.
- Improve the **quality of rural credit delivery**.
- Strengthen **governance and financial performance**.
- **Reduces intra-state competition** between RRBs.
- Boosts **financial inclusion** and digital banking in rural areas.
- Prepares RRBs for future **capital raising** and regulatory compliance.

Phase	Period	No. of RRBs
Pre-consolidation	Before FY06	196
Phase I	FY06–FY10	Reduced to 82
Phase II	FY13–FY15	Reduced to 56
Phase III	FY19–FY21	Reduced to 43
Phase IV	May 1, 2025	Reduced to 28

One RRB per State

- **Andhra Pradesh:**
  - **Merged banks:** Chaitanya Godavari, Andhra Pragathi, Saptagiri, Andhra Pradesh Grameena Vikas
  - **New name:** *Andhra Pradesh Grameena Bank*
  - **Sponsor Bank:** *Union Bank of India*
- **Uttar Pradesh:**
  - **Merged banks:** Baroda UP Bank, Aryavart Bank, Prathama UP Gramin Bank
  - **New name**: *Uttar Pradesh Gramin Bank*
  - **Sponsor Bank:** *Bank of Baroda*
- **West Bengal:**
  - Merged banks: Bangiya Gramin Vikash, Paschim Banga Gramin, Uttarbanga Kshetriya Gramin
  - **New name:** *West Bengal Gramin Bank*
  - Sponsor: *Notified*
- **Bihar:**
  - Dakshin Bihar Gramin and Uttar Bihar Gramin merged to form *Bihar Gramin Bank*
  - **Sponsor:** *Punjab National Bank*
- **Gujarat:**
  - Baroda Gujarat Gramin and Saurashtra Gramin merged to form *Gujarat Gramin Bank*
  - HQ: *Vadodara*
  - Sponsor: *Bank of Baroda*

Governance & Financials of RRBs

- Each **Regional Rural Bank (RRB) will have an authorised capital of ₹2,000 crore.**
- The ownership structure is divided among **three stakeholders**: the Central Government holds a **50% stake, the sponsor bank holds 35%, and the respective State Government holds 15%.**
- Following recent amendments to the **RRB Act, external capital raising is now permitted.** However, it is mandated that the combined holding of the Central Government and the sponsor bank must not fall below **51% to retain public sector control.**
- In terms of performance for the financial year **2023–24, RRBs** collectively posted their highest-ever net profit of **₹7,571 crore**. The **Capital Adequacy Ratio (CAR)** reached an all-time high of **14.2%,** indicating strong financial health. Additionally, the **Gross Non-Performing Assets (GNPA) ratio stood at 6.1%,** marking the lowest level in the past decade.

- **Jammu & Kashmir:**
  - J&K Grameen Bank and Ellaquai Dehati Bank merged to form *Jammu and Kashmir Grameen Bank*
  - HQ: *Jammu*
  - Sponsor: *J&K Bank*
- **Karnataka**
- **Madhya Pradesh**
- **Maharashtra**
- **Odisha**
- **Rajasthan**
- (***Each of the above states had two RRBs,*** *which are* ***now merged into one per state***).

Framework for Performance Verification Agency

Sub Topics: *Effects of liberalisation on the economy, changes in industrial policy and their effects on industrial growth.*

Context:

In a significant move aimed at **enhancing transparency in financial advertising,** the **Securities and Exchange Board of India (SEBI)** rolled out a **detailed framework for recognising and operationalising a performance verification body, to be known as the Past Risk and Return Verification Agency (PaRRVA).**

In a move aimed at strengthening the audit process and ensuring greater transparency, the Securities and Exchange Board of India (SEBI) announced a **standardised format for system and network audit reports of Market Infrastructure Institutions (MIIs)** — including stock exchanges, clearing corporations, and depositories. The new format is expected to enhance the efficiency and consistency of audits, making it easier to monitor and address issues across different institutions.

About PaRRVA

- The **primary objective of PaRRVA** will be to **validate historical performance claims made by research analysts, investment advisers, and stockbrokers** in advertisements and marketing materials.

Credit Rating Agencies (CRAs)

Credit Rating Agencies (CRAs) in India play a pivotal role in the financial ecosystem by evaluating the creditworthiness of entities, including corporations, government bodies, and financial institutions. Their assessments influence borrowing costs and investment decisions. India has several prominent credit rating agencies, **all regulated by the Securities and Exchange Board of India (SEBI) under the SEBI (Credit Rating Agencies) Regulations, 1999.** The top agencies include: **CRISIL (Credit Rating Information Services of India Limited), ICRA Limited, CARE Ratings (Credit Analysis and Research Limited), India Ratings and Research (Ind-Ra), Brickwork Ratings, Acuité Ratings & Research.**

- SEBI's move is a **direct response to growing concerns over misleading or exaggerated claims** in financial promotions, which can potentially misguide investors.
- As per the framework, **financial entities may only reference their past performance in public communications once it has been verified by PaRRVA using SEBI-specified risk-return metrics and procedures.**
- The idea for PaRRVA was **initially approved during SEBI's board meeting in December 2024,** and the regulator has now published operational guidelines to bring the agency into effect.

Eligibility Criteria for PaRRVA

SEBI has outlined **strict eligibility norms for credit rating agencies (CRAs)** seeking recognition as PaRRVA:

- Must have been **in existence for at least 15 years**
- Should possess a **minimum net worth of ₹100 crore**
- Must have **provided ratings to 250 or more issuers** of listed or proposed-to-be-listed debt securities
- Should maintain an **investor grievance redressal mechanism,** including provisions for online dispute resolution

Operational Details and Rollout Plan

- Eligible CRAs will undergo a **two-stage assessment process** by SEBI before receiving official recognition.
- Additionally, **CRAs must collaborate with a recognised stock exchange**, which will serve as the PaRRVA data centre—the technical backbone for storing and processing verification data.
- Once SEBI grants approval, the **CRA can begin PaRRVA services on a pilot basis for a period of two months.**
- Following the pilot phase, **a review will be conducted by an oversight committee,** and subject to any required changes in the operational framework, PaRRVA will commence full-scale operations for regulated entities and the general public.

Government Proposing to Increase FDI in Nuclear Sector

Sub Topic: *Effects of liberalisation on the economy, changes in industrial policy and their effects on industrial growth. Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

India is poised to make a historic shift in its nuclear energy policy, with the **government considering a proposal to allow foreign companies to own up to 49% stakes in the country's nuclear power plants.**

More on News

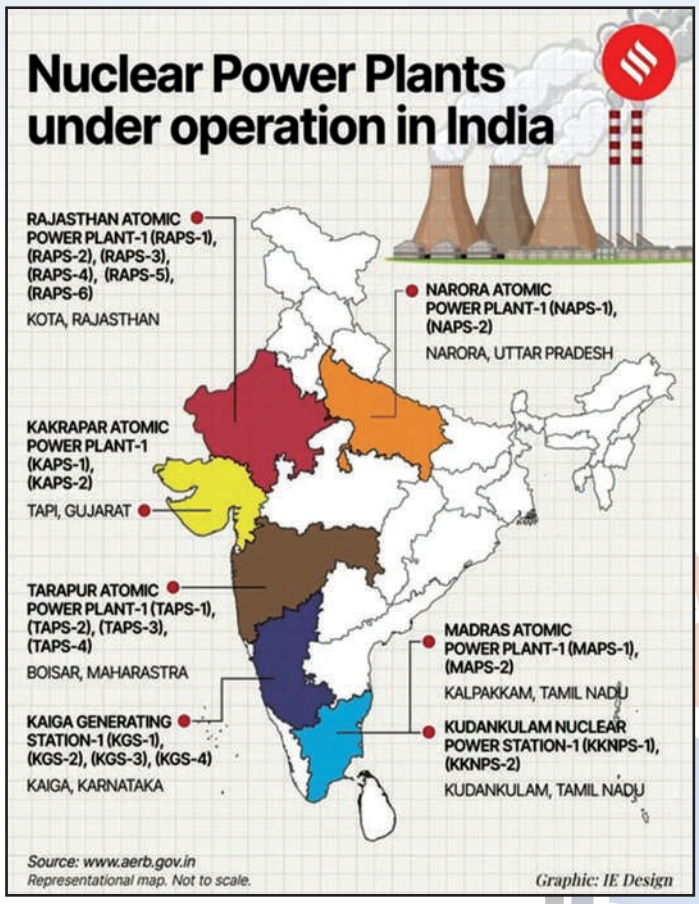
- This move, if approved, would mark the first time foreign investment is permitted in a sector that has been tightly controlled by the state since its inception.

Policy Shift Driven by Climate and Energy Needs

- The push for reform comes as India intensifies efforts to **transition from coal-based power generation to cleaner energy sources,** aiming to reduce carbon emissions and meet surging electricity demand.
- Currently, **nuclear energy accounts for just over 8 gigawatts (GW), or about 2% of India's total installed electricity capacity.**
  - The government's ambitious target is to increase nuclear capacity twelvefold to **100 GW by 2047.**

Key Features of the Proposal

- **Foreign Ownership Cap:** Foreign enterprises **could acquire up to 49% equity in nuclear power plants,** but all such investments would still require prior government approval and would not be automatically permitted.



- **Legal Amendments:** The government is preparing **amendments to the Atomic Energy Act of 1960 and the Civil Liability for Nuclear Damage Act of 2010.**
  - These changes, expected to be tabled in the July monsoon session of Parliament, would also allow private companies-both domestic and foreign-to build, own, and operate nuclear power plants, and to mine and manufacture atomic fuel.
- **Private Sector Entry:** Alongside foreign investment, major Indian conglomerates such as Reliance Industries, Tata Power, Adani Power, and Vedanta are in discussions to invest an estimated $26 billion in the nuclear sector.
- **International Interest:** Global nuclear giants including **Westinghouse Electric, GE-Hitachi, Electricité de France (EDF), and Russia's Rosatom** have expressed interest in participating as technology partners, suppliers, and service providers.

Background and Barriers

- India's nuclear sector has historically been off-limits to both foreign and private domestic investment due to **national security concerns and strict liability laws.**
- Although a **landmark civil nuclear agreement with the United States in 2008** paved the way for multi-billion-dollar deals, foreign companies remained hesitant due to the risk of unlimited liability in the event of a nuclear accident.
- The proposed amendments aim to address these concerns, potentially unlocking long-stalled international collaborations.

Implications and Next Steps

- **Boost to Clean Energy:** Expanding nuclear capacity is seen as essential for India to meet its climate goals and ensure reliable power, especially during periods when solar and wind generation are low.
- **Geopolitical and Economic Impact:** The policy shift could revive tariff negotiations and nuclear deals with countries like the United States, while also attracting significant foreign capital and technology.
- **Regulatory Oversight:** Despite liberalisation, the government will retain tight control, with all foreign investments subject to approval and oversight by relevant ministries and the Atomic Energy Department.

Mains

Rising Monsoon Intensity in Western Ghats

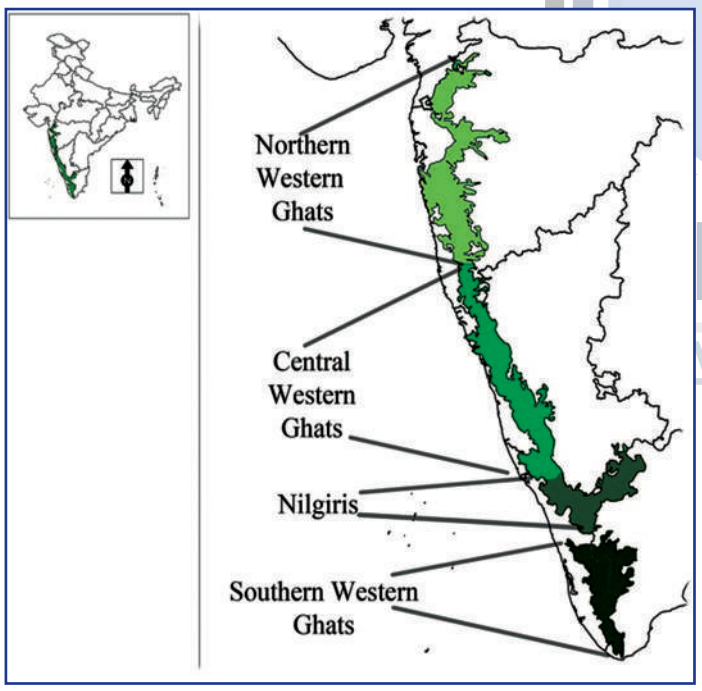
Sub Topic: *Indian Physical Geography, Monsoon*

Context:

A recent study by researchers at the Central University of Kerala (CUK) has uncovered a significant **increase in monsoon rainfall in the Western Ghats over the past 800 years.**

More on News

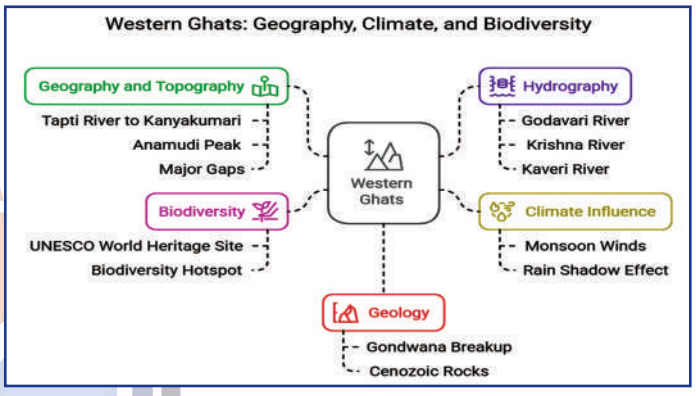
- By reconstructing Indian monsoon patterns spanning the last 1,600 years, the study provides **valuable insights into long-term climatic variations in the region.**



- The findings highlight **historical climate patterns in the Western Ghats and emphasise the urgency of proactive measures** to address challenges posed by an intensifying monsoon cycle.
- The **long-term increase in monsoon intensity could be linked to the rising frequency of extreme rainfall** events in recent years.

About Western Ghats

- The Western Ghats, also called the Sahyadri Hills, is a 1,600 km (990 mi) long mountain range running parallel to the western coast of India.
- It spans **six states: Gujarat, Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu,** covering an area of approximately 160,000 km² (62,000 sq mi).



Environmental Significance:

- The Western Ghats are vital for:
  - Water resources through river systems and reservoirs.
  - Climate regulation via monsoon interaction.
  - Biodiversity conservation due to its unique ecosystems.
- **Conservation:** Here are the main committees involved:
  - **Western Ghats Ecology Expert Panel (WGEEP):**
    - **Established:** 2010
    - **Chairperson: Prof. Madhav Gadgil**
    - **Purpose:** To assess the ecological status of the Western Ghats and recommend measures for its conservation.
  - **Key Recommendations:**
    - Proposed that **64%** of the Western Ghats be designated as **Ecologically Sensitive Zones (ESZ).**
    - Suggested the **establishment of a Western Ghats Ecology Authority** to manage conservation efforts.
    - Recommended strict regulations on developmental activities in sensitive areas, particularly in ESZ 1, where activities like mining and dam construction should be halted.
  - **High-Level Working Group (HLWG):**
    - **Established:** 2012
    - **Chairperson:** Dr. K. Kasturirangan

- **Purpose:** To review the recommendations made by the WGEEP and provide a balanced approach to conservation while considering development needs.

➢ **Key Recommendations:**

- Recommended designating only **37%** of the Western Ghats as **ecologically sensitive**, a significant reduction from the WGEEP's suggestion.
- Proposed a framework for sustainable development that allows for economic activities while protecting biodiversity.

Western Ghats and Indian Monsoon

The Western Ghats, a mountain range running parallel to the western coast of India, plays a pivotal role in shaping the Indian monsoon system.

Role in Monsoon Dynamics

❖ **Moisture Trapping:** The Western Ghats act as a barrier to the moisture-laden southwest monsoon winds coming from the Arabian Sea. These winds rise along the steep slopes of the mountains, cool down, and result in heavy rainfall on the windward side. This process creates a tropical monsoon climate along the western littoral. The forests of the Western Ghats contribute significantly to rainfall through **evapotranspiration,** accounting for up to 25% of the rainfall over peninsular India.

❖ **Rain Shadow Effect:** On the **leeward side (eastern slopes),** a rain shadow effect occurs, leading to **significantly lower rainfall.** This influences vegetation and climate, with scrublands dominating these drier regions.

➢ The western slopes receive annual rainfall ranging from 2,000–3,000 mm, with local extremes up to 10,000 mm. In contrast, the eastern slopes average about 1,000 mm.

❖ **Active and Break Periods:** The monsoon alternates between active periods of heavy rainfall and break periods with mini-droughts. During these breaks, **moisture from the vegetation of the Western Ghats contributes up to 50% of rainfall over regions like Tamil Nadu.**

Punjab's Ban on Hybrid Paddy Seeds

Sub Topic: *Agriculture, High Yield Variety Seeds*

Context:

The Punjab government has **banned the sale of hybrid paddy seeds (non-Basmati rice)**, citing concerns over their high cost and substandard performance during the milling process.

More on News

❖ According to the state government, these seeds result in a **higher percentage of broken rice** compared to the standards laid out by the **Food Corporation of India (FCI)**, thereby reducing the market value of farmers' produce.

❖ However, the ban has drawn criticism from **farmers and agricultural experts**, many of whom argue that hybrid seeds offer **superior yield and water-saving benefits** and that the real problem lies elsewhere.

Why Do Farmers in Punjab Prefer Hybrid Paddy Seeds?

❖ Punjab currently has **around eight hybrid paddy varieties officially recommended** for cultivation.

➢ These seeds are supplied by leading private seed companies such as **Savannah, VNR, Corteva, and Bayer**, and include popular varieties like **Sava 127, Sava 134, Sava 7501, 27P22, and VNR 203**.

❖ Farmers prefer these hybrid seeds for their **shorter growth cycles**, **higher productivity**, and **reduced stubble generation**.

➢ **Shorter growth duration** (around 125–130 days), leading to **water conservation** and faster maturity.

➢ **Higher yields**: Farmers report an increase in yield by **5–6 quintals per acre** compared to traditional varieties, with yields ranging from **35–40 quintals per acre**.

➢ **Increased income**: Farmers earn an additional **Rs 13,000 to Rs 14,000** per acre with hybrid varieties.

➢ **Reduced stubble**: Hybrid varieties produce **less stubble**, which is beneficial for environmental reasons.

Why Has the Government Imposed a Ban?

❖ **The Milling Issue:** During the **2024–25 Kharif marketing season**, millers across Punjab **refused to accept hybrid rice varieties**, citing that their **out turn ratio (OTR)** — the efficiency of converting paddy into white rice — was below the **FCI's prescribed minimum of 67%**. Millers claimed that the OTR for hybrid rice stood between **60% and 63%**, resulting in financial losses for them.

❖ **Historical Context:** In **2019**, Punjab imposed a similar ban on hybrid paddy seeds, but the decision was reversed to allow the sale of **centrally notified** hybrid varieties. The current ban raises questions about whether **notified and approved hybrid seeds** are included in the restriction.

Do Hybrid Paddy Seeds Lead to Lower Milling Efficiency?

❖ Many experts **dispute the millers' claims**, arguing that **low OTR is not due to the seeds themselves** but is a consequence of **harvest timing and post-harvest handling**. According to them, optimal OTR is achieved when:

- Paddy is harvested at **22–23% moisture**
- Sun-dried to **16–17% moisture** for procurement
- Milled at **13–14% moisture**

- Delays in drying and procurement, often caused by **logistical challenges**, lead to excessive breakage and lower OTR. Experts also point out that **many rice mills in Punjab operate with outdated technology**, contributing further to inefficiencies.
- Experts recommend that instead of banning seeds outright, the government should **crack down on unscrupulous dealers** who sell seeds at exorbitant prices and **ensure farmers get access to genuine, certified hybrids**.

What Does the Law Say About the Ban?

- **Conflict with National Laws:** Legal experts argue that Punjab's blanket ban on hybrid seeds, including those notified by the Centre, **contravenes national legislation**, specifically the **Seed Act, 1966**, and the **Seed Control Order, 1983** — both of which are under **central jurisdiction**.
  - "Under **Sections 6 and 7 of the Seed Act**, once a variety is notified by the Centre, including hybrids, it becomes a **legally approved seed**, and states **cannot arbitrarily prohibit its sale**.
  - The role of state governments is limited to **ensuring seed quality**, purity, and germination standards through certification and inspections — not issuing bans on centrally approved seeds.

Aerosols Climate

Sub Topic: *Environment, Pollution, Air Pollution*

Context:

A study published in **November 2024** in *Geophysical Research Letters* warns that **reducing aerosol emissions** without concurrently cutting greenhouse gas emissions could expose vulnerable populations to **accelerated warming** and **extreme heat**, particularly in regions like **India**.

Key Findings of the Study

- Regions that reduced air pollution in the late 20th century experienced greater warming over time.
- **Highly populated urban areas** with lower human development indices have seen less warming due to the masking effect of pollution.
- Abruptly stopping aerosol emissions can increase the rate of warming in the short term.

Understanding the Role of Aerosols and Greenhouse Gases

- **Greenhouse gases** (GHGs) trap heat and intensify global warming, leading to extreme temperature and rainfall patterns.
- **Aerosols**, such as sulphates and nitrates, scatter solar radiation, creating a **cooling effect** by blocking sunlight. However, aerosols are short-lived (lasting only days to weeks) compared to GHGs, which persist for centuries.
- The **warming effect** from GHGs is felt globally, while the cooling effect from aerosols is **localised** and varies by region and time.

The Indian Context: Thermal Power and Aerosol Emissions

- In India, thermal power plants (burning coal) produce roughly **70% of the country's electricity**. The burning process releases **sulphur dioxide**, which, through oxidation, forms **sulphate aerosols**, a major component of the country's aerosol load.
- **Sulphate aerosols** account for 50-60% of the aerosol composition in India, alongside black carbon, dust, and other pollutants, contributing to the regional cooling effect.

Invisible Cooling: The Role of Aerosols in India's Warming

- **Krishna AchutaRao** from IIT-Delhi noted that without aerosols, India would have experienced much greater warming.
  - From 1906 to 2005, India warmed by **0.54°C**, with about **2°C of warming due to greenhouse gases** offset by **1.5°C of cooling** from aerosols and other human activities.
- This cooling is part of a broader pattern of regional effects, with the **global cooling** from aerosols estimated at **0.6°C** but unevenly distributed (larger cooling in the northern hemisphere).

Aerosols and Rainfall: A Complex Relationship

- Aerosols have a **complicated effect on rainfall**. While their cooling effect on temperature is relatively straightforward, they may also **reduce monsoon rainfall** in India due to changes in atmospheric dynamics.
  - **IPCC report:** Aerosols cause **global cooling of about 0.6°C** (northern hemisphere: **0.9°C**, southern hemisphere: **0.3°C**).
- Aerosols have also been linked to **disrupted hydrological cycles** in other regions, such as **China**, where aerosol reductions have worsened extreme heat waves along the Pacific coast.

Net-Zero Emissions and Policy Implications

- Both **aerosol and GHG pollution** come from industrial activity. While aerosols provide cooling, they cause **severe respiratory diseases**. Cutting both requires **policies to protect vulnerable populations** from short-term heat spikes.
- **Indo-Gangetic plains** are particularly vulnerable due to high aerosol concentrations. Policymakers should focus on **long-term adaptation strategies** beyond net-zero targets.

Need for Better Heat Action Plans

- **Sustainable Futures Collaborative** analysed **nine Indian cities** and found their heat action plans lacked long-term strategies.
- Cities like **Delhi, Mumbai, Bengaluru, Faridabad, Gwalior, Kota, Ludhiana, Meerut, and Surat** need better heat stress mitigation plans.
- Removing aerosols could increase heat stress, necessitating **improved urban planning**.

The Trade-Offs

- Cleaning the air may accelerate warming but could **increase monsoon rainfall**.
- Balancing air quality improvement and climate mitigation is **critical for sustainable development**.
- Despite potential warming, **the health benefits of reducing air pollution far outweigh any negative climate effects**.

Govt Eyes 30% Ethanol Blending in Petrol by 2030

Sub Topic: *Environment, Biofuel, Ethanol*

Context:

India is preparing to announce a **new national target of 30% ethanol blending in petrol by 2030**, up from the current 20%. This decision comes as India **achieved 20% blending by March 2025**, five years ahead of the original 2030 deadline.

More on News

- Inter-ministerial discussions have **confirmed** that the government is now working toward a **30% blending target by 2030**.
- The debate is ongoing on whether to **implement this through a phased/staggered approach** or **adopt a single national target** directly.

Ethanol Blending Progress Timeline

- **Original target:** 20% ethanol blending by **2030**.
- **Revised target:** Moved forward to **2024–25 ethanol supply year** (Nov 1 – Oct 31).

What is Ethanol Blending?

- **Ethanol** (C2H5OH) is a biofuel, commonly made from the fermentation of sugar.
- In India, it is primarily **produced from sugarcane**, but other organic materials like food grains can also be used.
- The **Ethanol Blended Petrol (EBP) Programme** was launched by the government to **mix ethanol with petrol to reduce the consumption of fossil fuels**. The **E10 target** means that petrol now contains 10% ethanol.
  - **EBP Programme** launched pilot projects in **2001** at Miraj, Manmad (Maharashtra), and Aonla/Bareilly (Uttar Pradesh).
  - Officially started in **2003** with a **5%** ethanol blend in **9 states and 4 Union Territories (UTs)**.
  - Aimed at achieving **20% ethanol blending** in petrol by 2025-26.
- **Actual achievement:**
  - **2022–23 supply year:** 12.06% average blending.
  - **2023–24 supply year:** 14.6% average blending.
  - By **February 2025**, blending reached **19.6%** and crossed **20% by March**.

Economic and Environmental Benefits

- Over the last 10 years, ethanol blending by **public sector oil marketing companies (OMCs)** has resulted in:
  - **₹21.2 trillion in foreign exchange savings.**
  - **Crude oil substitution of 19.3 million metric tonnes.**
  - **Reduction of 62.6 million metric tonnes in carbon emissions.**
  - **Payments worth ₹21.04 trillion to farmers**, per ISMA.

Key Sectoral Data

- **Sugar sector contribution**: Ethanol production diverted from sugar: **2.1 million tonnes in 2023,** and **3.5 million tonnes in 2024**, showing a significant rise.
- **Retail penetration**: In **2014**, ethanol-blended petrol was sold at **27,900 outlets**. By **2024**, ethanol-blended petrol is available at **all retail outlets across India**.

Ethanol Supply and Allocation

- In the **2023–24 supply year**: **7.07 billion litres of ethanol** were already blended with petrol. OMCs allocated a total of **9.96 billion litres** for blending purposes.
- These achievements underscore the **government's proactive policy interventions** and the **industry's readiness** to support deeper ethanol integration into India's energy mix.

Rationale and Benefits

- **Energy Security:** Ethanol blending **reduces India's reliance on imported crude oil,** saving significant foreign exchange and enhancing self-reliance.
- **Environmental Impact:** Ethanol is a cleaner-burning fuel, helping to **reduce vehicular emissions, carbon monoxide,** and **particulate matter**, thus improving air quality and supporting **India's net-zero emissions target for 2070**.
- **Economic Impact:** The program supports **domestic agriculture by utilising sugarcane, maize, rice, and other biomass** for ethanol production, providing a market for surplus crops and reducing the need for sugar exports.

Challenges and Considerations

- **Feedstock Supply:** Achieving higher blending rates will require a substantial **increase in ethanol production, necessitating investments in distillation capacity** and **diversification of feedstocks beyond sugarcane**, such as damaged grains and maize.
- **Vehicle Compatibility:** Higher ethanol blends may require **modifications to existing vehicles** or the **introduction of flex-fuel vehicles** capable of running on higher ethanol concentrations.
- **Fuel Efficiency:** Studies indicate a **marginal reduction in fuel efficiency** for vehicles designed for lower ethanol blends when using higher blends like E20 or above.

Industry and Policy Initiatives

- The government has launched several initiatives to support ethanol production, including **financial incentives, reduced GST on ethanol**, and dedicated **programs for second-generation ethanol** from agricultural waste.
- The sugar industry has proposed even more ambitious targets, such as **50% blending by 2030**, contingent on further investments and policy support.

Global Risk Index for Mangroves

Sub Topic: *Environment, Vegetation, Mangroves*

Context:

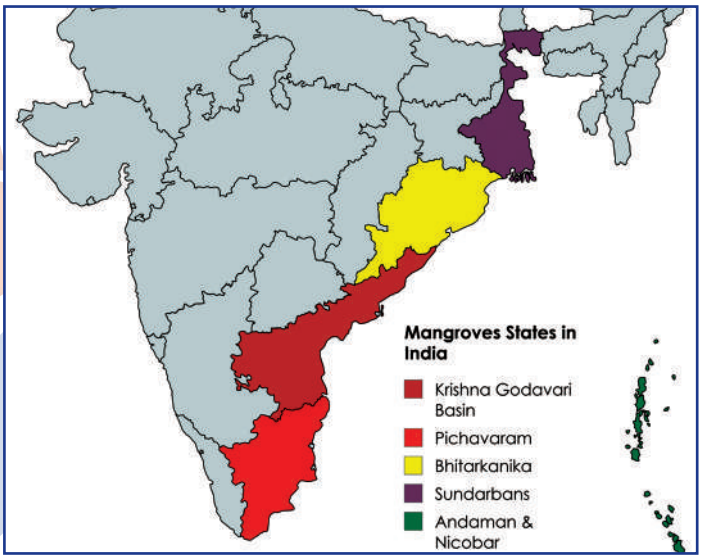
The study, published in *Communications Earth & Environment* on **April 5, 2025**, brings together researchers from **ETH Zurich** and the **University of Colorado Boulder**. The **risk index** developed in the study shows how **climate change**—especially **rising sea levels** and **stronger storms**—will affect mangrove ecosystems globally by **2100**.

More on News

- The risk was modelled under three climate change scenarios, or **Shared Socioeconomic Pathways (SSP)**, with varying levels of emissions:
  - **SSP2-4.5**: Moderate emissions
  - **SSP3-7.0**: Medium-high emissions
  - **SSP5-8.5**: Very high emissions

Key Findings

- **Risk to Mangroves by 2100:** The risk index shows that **over 56% of the world's mangroves** could face **high to severe risk** under the **worst-case scenario** (SSP5-8.5), which assumes very high emissions.
  - About **34% of the most valuable mangroves**, those crucial for **coastal protection, carbon storage, and fisheries**, could experience **irreversible damage** by 2100.



  - This damage is termed a **"regime shift"**, indicating a permanent change in the ecosystem that may not recover.
- **Climate Change Challenges:** Mangroves can handle small changes in sea level and moderate storms, but the increasing frequency and intensity of **tropical cyclones** and **rising sea levels** due to **climate change** may push them past their adaptive limits.
  - The combination of stronger storms and rising sea levels could create a **vicious cycle** where storms damage mangroves, causing **peat collapse** (land sinking) and preventing them from keeping pace with rising seas.

Key Risks to Mangroves

- **Storm Damage**: Tropical storms can kill mangrove trees. After storms, the land beneath mangroves may sink (due to **peat collapse**), making it harder for them to adapt to rising sea levels.
- **Ecosystem Services Under Threat**:
  - **Coastal Protection**: Mangroves block storm waves. However, storms can damage the forests, reducing their protective ability.

- **Carbon Storage**: Mangroves store large amounts of carbon. If destroyed, this carbon is released into the atmosphere, further exacerbating climate change.
- **Support for Fisheries**: Mangroves provide homes for fish and marine life. Their destruction can lead to a decline in fish populations, affecting food security and livelihoods.

Economic and Social Impacts

- **775 million people** globally depend on coastal ecosystems, with mangroves alone providing **$65 billion annually** in flood protection.
- The economic losses from mangrove destruction are not currently included in global climate damage discussions, despite their significant role in protecting infrastructure, food sources, and climate regulation.
- **Long-Term Concerns for Restoration:** Mangrove restoration efforts may fail if they are planted in areas that become increasingly vulnerable to climate change.
  - Mangroves take over **55 years** to reach full functionality, meaning that replanted mangroves might not grow fast enough to keep up with the rapidly changing conditions.

Global Initiatives

- **Mangrove Alliance for Climate:** Launched during the **27th Conference of Parties** to the **United Nations Framework Convention on Climate Change** in 2022, aims to promote mangrove conservation globally.
- The **International Union for Conservation of Nature** (IUCN) plays a crucial role in highlighting the importance of mangrove ecosystems and advocating for their protection worldwide.
- **Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI):** Launched in the 2023-24 Union Budget, MISHTI aims to restore/reforest mangroves covering approximately 540 km² across **nine states** and **three union territories** over five years.
  - It includes **financial assistance for local communities** to undertake mangrove plantations, awareness campaigns, and participatory approaches involving NGOs and community institutions.
  - It is expected to provide **indirect economic benefits worth INR 51.78 billion annually** and create an **additional carbon sink of 4.5 million tonnes** over ten years.
- **Central Sector Scheme on 'Conservation and Management of Mangroves and Coral Reefs':** Provides financial assistance to coastal states and union territories for implementing action plans specific to mangrove conservation, including surveys, alternative livelihoods, and awareness campaigns. It is part of the **National Coastal Mission Programme** under the Ministry of Environment, Forest & Climate Change.

Recommendations for Conservation

- The researchers urge that climate risks be incorporated into **mangrove conservation** and **blue carbon** planning:
- **Restoring Mangroves in Safer Areas**: Focus restoration efforts on locations less vulnerable to climate impacts.
- **Engineering Solutions**: Explore ways to help mangroves grow taller and withstand the effects of rising seas and stronger storms.
- **Species Adaptation**: Consider moving or mixing species to enhance resilience.
- **Inclusion of Climate Hazards in Studies**: Future research should incorporate additional climate threats such as **marine heatwaves** and **droughts**, and focus on how mangrove ecosystems can recover from disturbances.

Seaweed Farming as a Sustainable Livelihood

Sub Topic: *Agriculture, Sustainable Agriculture, Seaweed Farming*

Context:

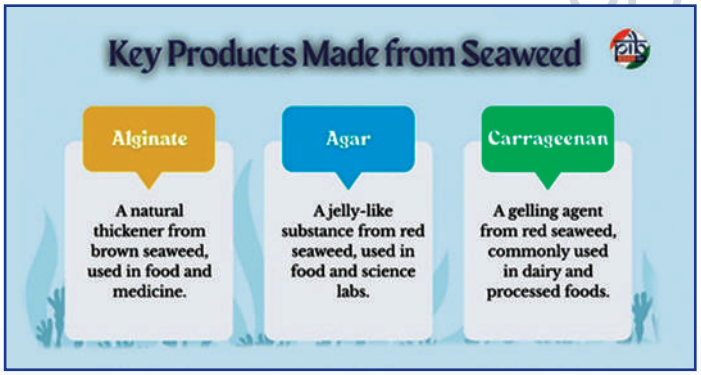
India, blessed with a vast **7,500 km-long coastline**, is uniquely positioned to harness the untapped potential of its marine resources. Among these, **seaweed farming is rapidly gaining recognition as a sustainable and profitable livelihood** for coastal communities, offering both economic and ecological benefits.

Seaweed: The Ocean's Green Gold

- Seaweed, **a marine plant found in oceans and seas,** is fast becoming a valuable commodity across sectors—from food and cosmetics to agriculture and medicine.
- It **thrives in shallow waters and requires neither land nor freshwater**, making it an **eco-friendly alternative to traditional crops.**
- **Rich in essential nutrients** such as vitamins, minerals, and amino acids, seaweed has **proven benefits in combating health issues like diabetes, cancer, arthritis, and heart disease.**

Multi-Billion Dollar Industry

- Beyond its nutritional benefits, seaweed is a **key raw material in several industries.** It is used to produce natural gelling agents like:
  - **Alginate (US$ 213 million):** Derived from brown seaweeds, used in food, cosmetics, and medical products.



  - **Agar (US$ 132 million):** Extracted from red seaweeds and widely used in desserts and laboratory media.
  - **Carrageenan (US$ 240 million):** Sourced from red seaweeds like Irish Moss, and used in dairy products and personal care items.
- **Historically consumed in Japan and China** since the 4th and 6th centuries respectively, **seaweed is now part of a global industry valued at around US$ 5.6 billion.**
  - A World Bank report projects that emerging markets could expand this to US$ 11.8 billion by 2030.

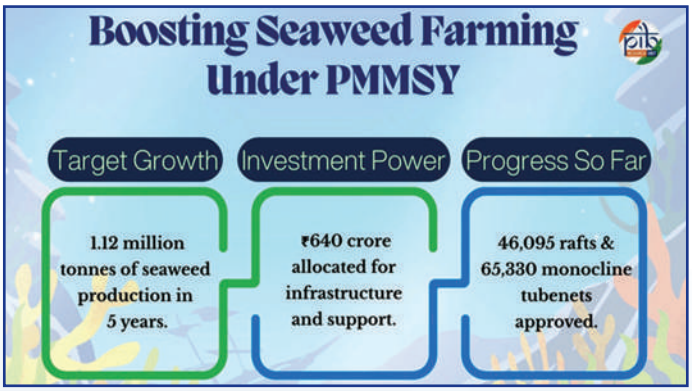
India's Push for Seaweed Cultivation

- Recognising its potential, the **Government of India is promoting seaweed farming through strategic investments and policy support.** Out of the 844 known seaweed species in India, around 60 hold commercial value.
- In 2020, the **Pradhan Mantri Matsya Sampada Yojana (PMMSY)** was launched with a ₹20,050 crore investment to transform the fisheries sector. Seaweed farming forms a core part of this initiative, with ₹640 crore earmarked for its development between 2020 and 2025.
- **Key initiatives include:**
  - Establishment of a Multipurpose **Seaweed Park in Tamil Nadu**
  - Creation of a **Seaweed Brood Bank in Daman and Diu**
  - Approval of over 46,000 rafts and 65,000 monocline tubenets for seaweed cultivation
- The goal is to scale production to 1.12 million tonnes in five years, opening new avenues for income generation and employment.

Environmental and Economic Advantages

Seaweed farming is not only economically promising but also environmentally sound. It offers several key benefits:

- **Biostimulants in Agriculture:** Seaweed-based biostimulants enhance plant growth, improve soil health, and boost crop resilience. The **Fertiliser (Control) Order, 1985, ensures quality regulation of these inputs.**



- **Support for Organic Farming:** Government schemes like **Paramparagat Krishi Vikas Yojana (PKVY) and MOVCDNER** promote the use of seaweed fertilisers in organic agriculture.

- **Climate and Ocean Health:** Seaweed absorbs carbon dioxide, combats climate change, cleans ocean waters, and supports marine biodiversity.
- **Lucrative Livelihoods:** Seaweed cultivation, especially of species like **Kappaphycus alvarezii,** can yield returns of up to ₹13.28 lakh per hectare annually. The demand for seaweed-based products like fertilisers and biofuels is growing globally, boosting foreign exchange earnings.

Inspiring Success Stories

Women Leading the Way in Tamil Nadu: In Mandapam, Tamil Nadu, women like Jeya Lakshmi, Thangam, and Kaleeswari **turned to seaweed farming after receiving training under the PMMSY scheme.** With modest investments and support from TAFCOFED, they began their ventures. Despite facing cyclones and market challenges, they produced 36,000 tonnes of wet seaweed, achieving financial independence and inspiring other women in their community.

Innovation with Tissue Culture: The **CSIR-Central Salt and Marine Chemicals Research Institute (CSIR-CSMCRI)** introduced tissue culture techniques to improve seaweed yield. In Tamil Nadu districts like Ramanathapuram and Tuticorin, farmers used these advanced seedlings to harvest 30 tonnes of seaweed in just two cycles—with better quality and 20–30% faster growth. This innovation is a game-changer for commercial cultivation.

The Hidden Oxygen Crisis: How Human Activities Are Suffocating Inland Waters

Sub Topic: *Environment, Pollution, Biological Oxygen Demand*

Context:

Inland waters like rivers, lakes, and reservoirs are vital to life on Earth. They play a crucial role in the planet's oxygen cycle. However, **a new study by Utrecht University** scientists **reveals that human activities are severely disrupting this cycle**, turning inland waters into oxygen-depleted zones.

Oxygen Depletion in Inland Waters

- Inland waters are experiencing growing hypoxia—oxygen depletion—which harms aquatic life and water quality.
- This is no longer just a local issue; it's a global concern impacting ecosystems worldwide.

Accelerated Oxygen Cycle

- A global model developed by researchers charts how oxygen is produced and consumed in inland waters.
- Findings reveal that oxygen turnover has increased, but consumption now outpaces production.
- Inland waters are becoming oxygen sinks, removing oxygen from the atmosphere faster than they can replenish it.

Major Human-Induced Causes

- **Nutrient Pollution**: Overuse of fertilisers leads to nutrient-rich runoff, boosting algae growth. When algae die, their decomposition uses massive amounts of oxygen.
- **Dams and Reservoirs**: Slower water movement due to dams increases oxygen consumption and delays oxygen renewal.
- **Wastewater**: Untreated or partially treated wastewater adds more organic material, further increasing oxygen use.

Impact of Climate Change

- Rising temperatures reduce the solubility of oxygen in water.
- Warmer conditions speed up biological processes that consume oxygen. Surprisingly, temperature contributes only about 10–20% to oxygen cycle changes—less than previously believed.

The Anthropocene Fingerprint

- Since 1900, the oxygen cycle in freshwater ecosystems has transformed significantly.
- Inland waters now remove nearly 1 billion tonnes of oxygen from the atmosphere annually—half as much as oceans emit. These small water bodies play a much larger role in Earth's oxygen and climate systems than previously recognised.

Inequality as a Barrier to Environmental Action

Sub Topic: *Environment, Urbanisation, Government Initiatives*

Context:

Renowned British environmentalist **Tony Juniper** highlights **inequality**—whether economic or social—as the biggest obstacle to tackling climate change, pollution, and biodiversity loss. His latest book, *Just Earth: How a Fairer World Will Save the Planet*, argues that **environmental sustainability and social justice must go hand in hand**.

The Need for Social Justice in Environmental Solutions

- Juniper's emphasis on **social justice** is crucial to solving environmental issues, explaining why collective efforts have failed so far.

- The UK's environmental sector, for instance, is notably **lacking diversity**, with only 3.5% of workers in environmental jobs identifying as ethnic minorities. This points to the broader **disconnection between environmentalism and working-class communities**.
- **Mainstream media** often portrays environmental issues as the concern of the **wealthy**, with phrases like "**middle-class tree huggers**" creating a barrier between the movement and those most affected by environmental harm.

Climate Anxiety Among Working-Class Communities

- Despite the media's portrayal, **39% of UK working-class voters** experience **climate anxiety**, just slightly lower than the **42%** of middle-class voters.
- Climate concern has remained high even through the **COVID-19 pandemic** and **cost-of-living crises**, suggesting that climate change is a pressing issue across social classes.

Global Tensions Over Fairness in Climate Action

- At the global level, there are ongoing tensions between **developed** and **developing countries** regarding what constitutes a "**fair**" climate future.
- Developed nations, such as the **US** and **EU**, have historically held power in shaping climate agreements, often creating an **unjust regime** that favours their interests.
- Disputes continue over how to fund **loss and damage**, particularly in vulnerable regions where rising sea levels or droughts could render entire communities uninhabitable.

Juniper's Vision for a Fairer, Greener Society

- Juniper proposes a **"just transition"**—a shift towards a greener society that also addresses issues of **social justice**.
- While the concept of a just transition has evolved over time, Juniper sees it as a crucial framework for **climate justice**.
- His **ten-point agenda** for a just transition includes:
  - **Measuring progress by well-being** and **sustainable consumption**, rather than GDP growth.
  - **Reallocating subsidies** from fossil fuels to **green energy**.
  - **Carbon tax regimes** and additional **public resources** for environmental protection and climate resilience.
  - The use of **ecocide law** to protect future generations.

Addressing Rising Inequality and Environmental Consumption

- **Rising inequality**, especially after the **COVID-19 pandemic**, has deepened the divide between the **rich and the poor**. Juniper points out that the **wealthiest 10%** are responsible for more **greenhouse gas emissions** than the **poorest 50%**.
- The **unfairness** is evident in how those contributing the least to environmental destruction are hit hardest by its impacts.
- Juniper critiques the conventional focus on **indefinite economic growth** and calls for a cultural shift away from **consumption**, **competition**, and the **devaluation of nature**.

Realistic Hope for Change

- Although Juniper presents a **realistic** view of the challenges ahead, he remains hopeful that **progress is possible**.
- His ultimate message is that **society must shift towards a fairer, more sustainable future**, as he poignantly concludes: **"We have nowhere else to go. There is just Earth."**

Prelims

Earth Splitting Beneath the Himalayas

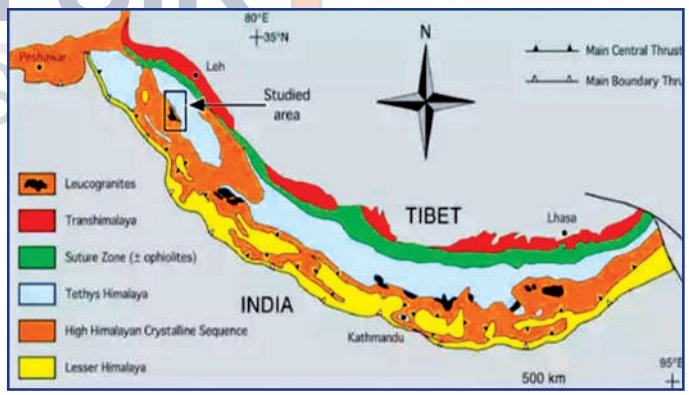
Sub Topic: *Salient features of the world's physical geography. Important Geophysical phenomena, geographical features and their location-changes in critical geographical features.*

Context:

The majestic Himalayas, the world's tallest mountain range, were formed about 60 million years ago due to the colossal collision between two massive tectonic plates—the **Indian plate and the Eurasian plate.**

More on News

- This ongoing collision has **shaped not only the breathtaking landscape but also the seismic activity that frequently rattles South Asia.**



  - For decades, scientists believed that the Indian plate was steadily sliding beneath the Eurasian plate in a smooth, continuous manner, gradually lifting the Tibetan Plateau and building the mountains over millions of years.
- Recent seismic data reveals that **deep beneath Tibet,** the **Indian plate is not simply sliding under the Eurasian plate—it is actually splitting into two parts.**

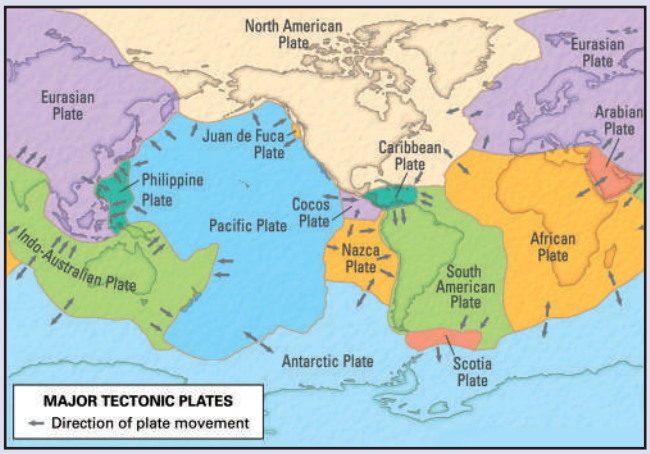
- This discovery, presented at the American Geophysical Union conference in San Francisco, offers a **fresh perspective on the tectonic forces shaping one of Earth's most geologically active regions.**

What's Happening Beneath the Surface?

- Instead of a smooth subduction, the **Indian plate is undergoing a rare and dramatic process known as delamination.**
  - In this process, the **denser lower portion of the plate is peeling away and sinking into the Earth's mantle, while the lighter upper portion continues moving just beneath the surface.**
- **Some parts of the Indian plate remain intact, but other regions are fragmenting roughly 100 kilometers below the surface,** showing signs of extreme internal stress and deformation.

Theory of Plate Tectonics

The theory of plate tectonics is the **scientific explanation that Earth's outer shell,** called the **lithosphere, is divided into several large and small rigid plates that have been slowly moving for billions of years.** These **tectonic plates float and glide over the semi-fluid, partially molten layer beneath them known as the asthenosphere, which allows their movement.** The lithosphere includes the crust and the uppermost mantle, and it is broken into about seven or eight major plates along with many smaller ones. **The plates interact at their boundaries, which are classified as:**



- **Divergent boundaries:** where plates move apart, forming mid-ocean ridges and rift valleys.
- **Convergent boundaries:** where plates move toward each other, causing subduction zones, mountain building, and volcanic arcs.
- **Transform boundaries:** where plates slide past each other horizontally, often causing earthquakes.

Plate tectonics **explains many geological phenomena such as earthquakes, volcanic activity, mountain formation, and ocean trench development,** which mostly occur along plate boundaries. The movement of plates is driven primarily by mantle convection—heat-induced circulation in the Earth's mantle—as well as the pull of dense, sinking oceanic lithosphere and other forces.

Tectonic Plates Tearing Apart

- Contrary to the previous assumption of the Indian plate acting as a rigid slab sliding beneath its neighbor, the new findings indicate that the **plate is splitting and breaking apart internally.**
- The **lower half is being pulled deeper into the mantle,** a peeling effect rarely seen in continental collisions.
- This suggests that the **base of the Indian plate is deforming dramatically as it descends into the Earth's hot interior.**

'Mission Anveshan' Seismic Survey Scheme

Sub Topic: *Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

The central government is considering an **extension of the 'Mission Anveshan' scheme by another year,** amid its ongoing efforts to boost domestic oil and gas exploration for enhanced energy security.

More on News

- Originally launched in FY25, the scheme is **currently set to conclude in FY26.**
- However, the government may now continue it through FY27 to ensure wider seismic survey coverage of India's sedimentary basins.

What is Mission Anveshan?

- Mission Anveshan is **an incentive-based scheme** launched **to support seismic surveys aimed at discovering new hydrocarbon reserves.**
- The initiative provides **financial support to state-run companies such as Oil and Natural Gas Corporation Ltd (ONGC) and Oil India Ltd (OIL)** to undertake seismic data acquisition, processing, interpretation, and mapping.
- This mission is a **continuation of the National Seismic Programme (NSP),** with the goal of accelerating exploration activities in India's unexplored sedimentary basins, which are believed to hold significant untapped hydrocarbon potential.

Coverage and Budgetary Allocation

- The scheme was approved with a **budgetary outlay of ₹720 crore** for two years (FY25–FY26).
- The target is to **conduct two-dimensional (2D) seismic surveys** covering 20,275 line-kilometers (LKM) across seven key on-land sedimentary basins: **Ganga-Punjab, Rajasthan, Saurashtra, Deccan Syneclise, Cuddappah, Krishna-Godavari, and Chhattisgarh.**

Progress So Far and Implementation Challenges

- Oil India has already begun seismic data collection in the Ganga-Punjab and Rajasthan basins, having completed approximately 1,683 LKM of 2D seismic surveys.
  - However, ONGC's progress has been hampered due to contractual litigation.
- Despite the delays, ONGC has initiated experimental surveys in the Cuddappah region of Andhra Pradesh, with full-scale seismic data acquisition expected to commence soon.
- A standing committee report presented to Parliament in March urged the government to closely monitor the scheme's implementation and ensure timely execution of surveys to improve the availability of geo-scientific data for investors.

Emphasis on 3D Seismic Surveys for Accuracy

- Going forward, the focus is expected to shift increasingly towards three-dimensional (3D) seismic surveys.
- These surveys offer superior accuracy and deeper insights into subsurface geological structures compared to traditional 2D surveys, making them critical for successful exploration, especially in deepwater and ultra-deepwater regions.

Policy Recommendations and Investor Push

- The Parliamentary Standing Committee on Petroleum and Natural Gas, chaired by Sunil Dattatray Tatkare (MP from Raigad, Maharashtra), recommended time-bound completion of seismic surveys and timely fund disbursement to prevent work disruptions.
- The panel emphasised that comprehensive geoscientific data would make India a more attractive destination for global oil and gas explorers, particularly in offshore segments.

Climate Change and Arctic Fjords

Sub Topic: *Distribution of key natural resources across the world. Important Geophysical phenomena such as earthquakes, Tsunami, Volcanic activity, cyclones. etc..*

Context:

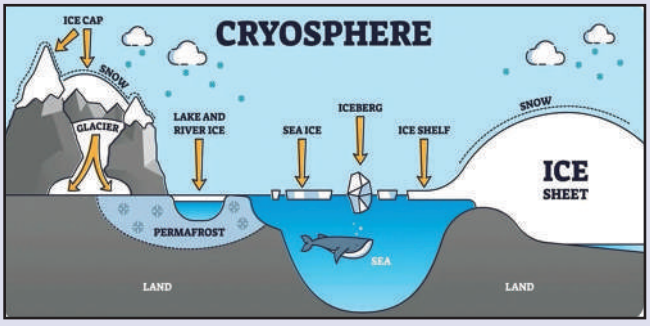
A groundbreaking new study led by Jochen Knies of the iC3 Polar Research Hub reveals alarming signs that **climate change is weakening Arctic fjords' ability to act as vital carbon sinks.**

More on News

- As the world continues to warm, the **capacity of polar oceans to remove carbon dioxide from the atmosphere could be significantly reduced,** posing a major threat to global climate stability.

Cryosphere

The cryosphere refers to the **portions of the Earth's surface where water is in solid form,** including **snow, river and lake ice, sea ice, glaciers, ice shelves, ice sheets, and permafrost.** It plays a fundamental role in the Earth's climate system, influencing the surface energy budget, water cycle, primary productivity, gas exchange, and sea level. The **cryosphere acts as a natural integrator of climate variability and provides some of the most visible indicators of climate change.** The cryosphere is essential for **regulating global and regional climates,** supporting water resources, and maintaining ecological balance. In regions like the Himalayas-often called the **"Third Pole"**-the **cryosphere comprises vast quantities of ice and snow, glaciers, and permafrost.** It serves as a **critical freshwater source for major river systems** (e.g., Indus, Ganges, Brahmaputra), supporting the livelihoods of more than a billion people downstream.



Arctic Fjords Under Pressure from Rapid Climate Shifts

- Published in Communications Earth & Environment, Knies and his team detail **how rapidly melting ice is transforming vibrant Arctic fjord ecosystems,** with **Svalbard's Kongsfjorden as a key case study.**
- The researchers document **major shifts in phytoplankton communities**—microscopic organisms at the heart of the Arctic food web—and warn of a concerning decline in the fjords' carbon sequestration abilities.
- These changes suggest that the **future of Arctic fjord ecosystems will depend heavily on how well they can adapt to a warmer climate**.

Crucial Role of Phytoplankton in Carbon Cycling

- **Phytoplankton,** often called the **hidden heroes of the ocean,** are microscopic plants that **not only form the base of the Arctic food chain but also play a critical role in regulating Earth's climate.**

- As melting ice exposes more of the ocean's surface to sunlight, **phytoplankton blooms flourish, providing an abundant food source for fish, marine mammals, and seabirds.**
- However, this apparent boon is a **double-edged sword.**
- While warmer temperatures initially boost phytoplankton growth during long Arctic summers, the resulting water stratification—where warmer, lighter water sits atop colder, nutrient-rich layers—limits the access to essential nutrients.

Fjords

A fjord is a **long, narrow, deep inlet of the sea between high cliffs or steep slopes, created by the action of glaciers.** Fjords are **among the most dramatic and visually striking landforms on Earth,** characterised by their **U-shaped valleys and steep rock faces.**

How Are Fjords Formed?

- Fjords are formed **when glaciers carve out deep valleys below sea level through a combination of ice segregation and abrasion of the surrounding bedrock.**
- As the glaciers retreat and melt, **seawater floods these valleys, creating the characteristic deep, narrow inlets.**
- **Most fjords are deeper than the adjacent sea,** often with a sill or shoal (bedrock rise) at their mouth due to reduced glacial erosion and terminal moraine deposits.

Key Features of Fjords:

- **Steep Cliffs:** Fjords are surrounded by steep cliffs or slopes on three sides, with the fourth side opening to the sea.
- **Depth:** Many fjords are exceptionally deep, especially further inland where the glacial action was strongest. For example, **Norway's Sognefjord** reaches depths of over 1,300 meters (4,265 feet) below sea level.
- **Sills and Thresholds:** The mouth of a fjord often features a shallow rise or sill, which can create strong tidal currents or saltwater rapids.
- **Brackish Water:** Fjords often have layers of brackish water due to the mixing of freshwater from rivers and glacial melt with seawater.

Where Are Fjords Found?

- Fjords are most commonly found in regions that were heavily glaciated during the last Ice Ages, particularly in the higher middle and high latitudes. Major fjord regions include: Norway (which has nearly 1,200 fjords), Greenland, Chile, New Zealand, Canada (British Columbia, Newfoundland and Labrador, Quebec, Nunavut), Alaska (USA), Scotland, Russia, Antarctica, and the Faroe Islands.

Ecological and Environmental Importance:

- **Unique Ecosystems:** Fjords serve as important transition zones between land and sea, supporting diverse marine and terrestrial habitats.
- **Carbon Storage:** Despite covering just 0.1% of the ocean's surface, fjords store an outsized 11-12% of the ocean's carbon, acting as significant carbon sinks during interglacial periods.
- **Human Use:** Fjords are valuable for sea ports, tourism, aquaculture, and as natural harbours due to their sheltered conditions.

Urban Wildflowers Found to Transfer Toxic Metals to Pollinators

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

New research from the University of Cambridge reveals hidden dangers in urban ecosystems, as wildflowers growing in contaminated soils pass toxic metals to bees through their nectar.

More on News

- Study based on **vacant, post-industrial plots in Cleveland, Ohio, USA** — areas previously used for **iron and steel production, oil refining, and automobile manufacturing**.
- Researchers analysed nectar from various wildflower species.
- **Species-specific responses** observed, based on strategies like **metal avoidance, detoxification, and biochemical tolerance**.

Key Species Findings

- **Chicory (Cichorium intybus)**: Highest **total metal concentration**.

- **White clover (Trifolium repens)**: Highest **lead** concentration in nectar.
- **Wild carrot (Daucus carota)**: Highest **cadmium** levels.
- **Bindweed (Convolvulus arvensis)**: Moderate levels across metals.
- **Milkweed (Asclepias syriaca)**: Highest **arsenic** uptake.
- **Common dandelion (Taraxacum officinale)**: Showed **no significant variation** in metal uptake, suggesting an ability to **limit metal transfer** into nectar.

Contaminated Soils and Metal Uptake

- **Urban soil contamination** is a global issue, with levels increasing with the age of a city.
- Sources include **cement dust, mining, and industrial waste**.
- Wildflowers absorb toxic **trace metals** from these soils: **Arsenic** (lowest)**, Cadmium, Chromium,** and **Lead** (highest)**.**

Impact on Pollinators

- **Bees foraging** on wildflowers ingest these toxic metals through **contaminated nectar**.
- Consequences of metal ingestion include:
  - **Impaired health**
  - **Reduced population sizes**
  - **Increased mortality rates**
  - Even **low metal levels** affect **learning and memory**, impacting **foraging behaviour**.

Policy and Conservation Recommendations

- Researchers recommend **evaluating land-use history** before **planting wildflowers** in urban areas.
- Emphasise the need to balance pollinator conservation with **awareness of soil contamination**.
- The study aims to **raise awareness** about: **Urban soil quality, Pollinator health.**

Wider Context

- **Pollinators** like bees are critical for crops including **apples and tomatoes**.
- **Wild pollinator populations** have **declined by over 50%** in the past **50 years**.
- **Major contributing factors:**
  - **Land-use changes**
  - **Climate change**
  - **Pesticide use**
  - **Loss of flower-rich habitats**

Toxic Metals in Soil Threaten Global Food Security

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

A groundbreaking global **study published in *Science* on April 17, 2025**, has uncovered alarming levels of **toxic heavy metal contamination in agricultural soils** worldwide, posing a growing threat to **food security, public health**, and **ecosystems**.

Key Findings

- The findings are based on analysis of over **1,000 regional datasets** by lead researcher **Deyi Hou** from **Tsinghua University, China**.
- **14-17% of the world's agricultural soils** have been found to **exceed safe thresholds for at least one hazardous metal**, affecting an estimated **900 million to 1.4 billion people** living in high-risk regions.

- The study suggests that these pollutants are not only diminishing **crop yields** but also **contaminating global food supplies**. Despite its extensive scope, the study acknowledges that the problem may be **significantly underestimated** due to a **lack of comprehensive soil monitoring** in many developing areas, particularly in **sub-Saharan Africa, northern Russia**, and **parts of central India**.
- Researchers are calling for **international cooperation and funding** to expand soil testing in these underrepresented regions.

Historical and Natural Drivers

- One of the study's most striking discoveries is the identification of a **heavily polluted belt stretching across low-latitude Eurasia**.

- This zone includes **southern Europe, the Middle East, South Asia**, and **southern China**—regions that were once home to the ancient Greeks, Romans, Persians, and Chinese dynasties.

- The researchers attribute this contamination to **centuries of human activity** such as **mining, metal smelting**, and **agriculture**, compounded by natural factors like **metal-rich bedrock** and **low rainfall**, which hinders pollutant dilution.
- The enduring nature of these heavy metals—unlike organic pollutants, they **do not degrade over time**—makes this a defining environmental marker of the **Anthropocene**, the human-dominated geological epoch.

Key Contaminants and Regional Hotspots

The study highlights significant regional disparities in the types and levels of soil contamination:

- **Cadmium**: The most widespread pollutant, found at dangerous levels in **9% of global agricultural soils**. Hotspots include **northern and central India, Pakistan, Bangladesh, southern China**, and parts of **Africa and Latin America**.
- **Nickel and Chromium**: High concentrations are prevalent in the **Middle East, subarctic Russia**, and **eastern Africa**.
- **Arsenic**: Concentrated in **southern China, Southeast Asia**, and **West Africa**.
- **Cobalt**: Linked to mining activities, cobalt pollution is especially severe in **Zambia, the Democratic Republic of the Congo (DRC)**, and **Ethiopia**.
- These findings suggest that metal contamination is not a localised issue but a **global crisis**, with implications far beyond the affected regions.

Implications

- **Food Security:** Toxic metals are absorbed by crops, **reducing yields** and **contaminating food chains**. The **global food trade** risks spreading contamination from these hotspots to wider regions, threatening **global food safety**.
- **Public Health:** Heavy metals are linked to **neurological damage, cancer, kidney failure**, and **reproductive health issues**. Populations in affected areas face **chronic exposure**, especially where **soil-to-plate pathways** are poorly regulated.
- **Environmental and Ecosystem Degradation:** Soil contamination affects **microbial health**, reduces biodiversity, and damages long-term **agro-ecological balance**.

A Growing Problem Amid Rising Metal Demand

- The situation is expected to worsen. As demand for metals rises with the expansion of **modern technologies**—from electronics to electric vehicles—the risk of pollution from mining and industrial activities will continue to grow.
- **Historical data underscores this trend:**
  - In **China**, the first national soil survey in 2014 revealed that **16% of all land** and **19% of farmland** exceeded pollution limits.
  - In the **European Union**, a 2016 study found that **28% of tested soils** surpassed heavy metal safety thresholds.
    - These numbers emphasise the urgency of coordinated action to mitigate the risks.

Climate Change May Raise Arsenic in Rice

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

A groundbreaking **study published in *Lancet Planetary Health*** on **April 16** warns that **rising global temperatures** and **elevated carbon dioxide levels** could significantly **increase arsenic concentrations in rice,** posing a serious **public health risk—particularly in Asia**, where rice is a dietary staple.

Key Findings

- The **research**, led **by Dongming Wang of the Chinese Academy of Sciences,** represents one of the first long-term, field-based studies to examine how climate change could alter the chemical composition of rice.
- The study's findings suggest that when **carbon dioxide (CO_2) concentrations and temperatures exceed the 2°C threshold**, they interact to raise the levels of **inorganic arsenic** in rice grains. This phenomenon is likely driven by **shifts in soil chemistry** that increase arsenic uptake by rice plants.

Elevated Arsenic, Elevated Health Risks

- Inorganic arsenic is a known carcinogen linked to **lung and bladder cancers**, as well as **cardiovascular disease** and other chronic health conditions. The researchers warn that climate-related arsenic increases in rice could elevate lifetime cancer and health risks across much of Asia by **2050**.
- Using **Free-Air CO_2 Enrichment (FACE)** technology, the international team analysed 28 rice varieties over a decade, modeling future risks based on four climate scenarios.
  - Their projections focused on seven Asian nations: **Bangladesh, China, India, Indonesia, Myanmar, the Philippines,** and **Vietnam**.
- By factoring in regional **population sizes**, **rice consumption rates**, and the extent of **flood-irrigated rice farmland**, the study estimated future **daily inorganic arsenic intake** and the **resulting health impacts**.

China May Face the Greatest Burden

The projections were stark. **China** is expected to bear the highest health burden, with an estimated **13.4 million additional lifetime cancer cases** by 2050 attributable to increased arsenic in rice alone.

Other nations in the region could also see sharp increases in cancer and related illnesses if adaptation strategies are not implemented.

Why is Rice Vulnerable?

- Co-author **Lewis Ziska** of Columbia University's Mailman School of Public Health noted that rice's cultivation in **flooded fields**—a method that reduces weed growth—also makes it more vulnerable to arsenic absorption.
- Arsenic, present in both soil and irrigation water, becomes more bioavailable in such conditions, especially when influenced by climate-driven changes in soil chemistry.
- Ziska emphasised that with **billions of people depending on rice as a staple food**, any widespread increase in arsenic content could trigger **global health crises**, particularly in vulnerable populations with high rice consumption and limited dietary diversity.

Indian Experts Call for Immediate Ban on Chlorpyrifos

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The **2025 Conferences of the Parties (BRS COP)** to the **Basel, Rotterdam, and Stockholm Conventions** will be held in **Geneva, Switzerland**. These are **multilateral environmental agreements** aimed at **protecting human health and the environment** from hazardous chemicals and wastes.

Other Pesticides Under Review

- **Paraquat**
- **Acetochlor**
- **Carbosulfan**
- **Iprodione**
- **Methyl bromide**
- **Fenthion**

More on News

- The summit includes: **BC COP-17** (Basel Convention), **RC COP-12** (Rotterdam Convention), and **SC COP-12** (Stockholm Convention).
- In addition to chlorpyrifos, the BRS summit will examine other pesticides. These may be added to **Annex III** of the **Rotterdam Convention**, enhancing global **transparency and accountability** in the trade of hazardous chemicals.

Chlorpyrifos and its Hazards

- **Chlorpyrifos** is a **moderately hazardous pesticide** according to the **World Health Organisation (WHO)**.
- It remains widely used in **India**, despite being banned in over **40 countries**.
- **Health risks include**:
  - **Neurotoxicity** (brain damage, particularly in unborn children).
  - **Reproductive toxicity**.
  - It can **contaminate remote ecosystems**, travelling thousands of miles.
- **PAN India** and experts are urging for its **global ban**.

India's Use and Global Context

- Approved for use on **18 crops** in India.
- **Over 40 countries** have already banned chlorpyrifos.
- A **2022 report** revealed **unapproved and unauthorised use** of chlorpyrifos and other hazardous chemicals like **paraquat** across India.
- India still allows the use of **many pesticide ingredients banned elsewhere** — (According to the **Consolidated List of Banned Pesticides**) 568 such substances are flagged in global bans.
- This points to the urgent need for **India to align with international best practices** on chemical safety.

What Experts Are Demanding?

- **Pesticide Action Network (PAN) India** calls for: Listing **chlorpyrifos under Annex III** of the **Rotterdam Convention** (requiring **prior informed consent** for international trade).
  - Listing under **Annex A** of the **Stockholm Convention** (which mandates a **global ban**).
- PAN India insists on **no exemptions**, citing the **availability of safer alternatives**.

Stockholm Convention and Persistent Organic Pollutants

- The **Stockholm Convention** (adopted in 2001) aims to eliminate or restrict **persistent organic pollutants** (POPs) that:
  - **Persist in the environment**.
  - **Bio-accumulate** in wildlife and humans.
  - **Cause long-term ecological and health damage**.

Global Coral Bleaching Reaches Unprecedented Levels

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment. Critical geographical features (including water-bodies and ice-caps) and in flora and fauna.*

Context:

The **world's coral reefs** are experiencing the most widespread and **intense bleaching event in recorded history**, with 84% of global reef areas now affected, according to a new announcement from the **International Coral Reef Initiative (ICRI)**.

More on News

- This marks the **fourth global bleaching event since 1998**, but it has now surpassed the severity of the **2014–2017 event**, which impacted about **two-thirds of the world's reefs**.
- The **current crisis, which began in 2023**, is **driven by warming ocean temperatures**, and experts warn that there's no clear end in sight.
- NOAA's **Coral Reef Watch program** has had to **add new levels** to its bleaching alert scale due to rising risks.

***Coral reefs** are vital ecosystems, often referred to as the **"rainforests of the sea,"** supporting around **25%** of all marine life. They are **critical for global biodiversity, seafood production, tourism**, and the protection of coastal regions from erosion and extreme weather events.*

Cause: Ocean Warming

- Triggered by **warming oceans**, largely due to **climate change** and **greenhouse gas emissions**. Greenhouse gases like **carbon dioxide and methane**, largely from **burning fossil fuels**, are the primary drivers.
- In **2023**, Earth experienced its **hottest year on record**.
- **Average annual sea surface temperature** (excluding polar regions) reached a record **20.87°C (69.57°F)**. Such temperatures are **lethal to corals**, triggering mass bleaching.
- The current crisis is **threatening the ability of oceans to sustain marine life and human livelihoods**.

What Happens During Bleaching?

- Corals depend on **colourful algae (zooxanthellae)** that live inside them and provide food.
- Prolonged heat causes the algae to produce **toxic compounds**, prompting the corals to expel them.
- This leads to **coral bleaching**—corals turn stark white and become vulnerable to death.

Conservation Efforts

- **Coral propagation labs**, like one in the Netherlands, are growing coral fragments for future reef restoration.
- In **Florida**, teams are rescuing and nursing heat-endangered corals back to health.
- Despite these efforts, scientists emphasise that such measures are **only temporary solutions**. Experts agree that **reducing greenhouse gas emissions** is the only long-term solution.

Global Initiative 'Revive Our Ocean' Launched

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

On April 24, 2025, a major new global initiative, ***'Revive Our Ocean'***, was officially launched with the **aim of empowering coastal communities to lead marine conservation efforts.**

More on News

- The program focuses on **scaling up effective, community-led marine protected areas (MPAs)** by removing barriers that prevent local stewardship of ocean resources.

New Wave of Ocean Conservation

- **Community-Driven:** 'Revive Our Ocean' is **grounded in proven community-driven models** from around the world.
- **Countries:** Initially, the **initiative will target seven countries: the United Kingdom, Portugal, Greece, Turkey, Philippines, Indonesia, and Mexico.**
- **Effective Protection:** The initiative is **designed to inspire, equip, and support communities** to create and **manage marine protected areas more effectively.**
- **KMGBF:** It seeks to **address the urgent need to protect marine biodiversity in line with the 30X30 target of the Kunming-Montreal Global Biodiversity Framework (KMGBF)** — an ambitious global goal to conserve 30% of the world's oceans by 2030.

Urgent Need for Stronger Marine Protected Areas

- Currently, **over 16,000 MPAs exist globally,** covering approximately **8% of the world's oceans, according to the Protected Planet Report 2024.**

- However, **only 3% of these areas are under full protection.**
- **Many MPAs are poorly managed and still permit damaging activities** such as bottom trawling, which devastates marine ecosystems.

- Marine Protected Areas are **critical for safeguarding marine biodiversity, supporting fisheries, enhancing carbon sequestration, and boosting local economies through tourism.**
  - They are managed through various models, including national governments, local authorities, NGOs, or co-managed with communities.

Tackling the Barriers to Community-Led Marine Protection

- Despite proven success stories, community-led MPAs remain rare. According to the 'Revive Our Ocean' team, three major barriers stand in the way:
  - Lack of awareness about the benefits of MPAs.
  - National policies restricting local governments from establishing MPAs.
  - Insufficient tools, training, and financial support for communities.
- To overcome these challenges, 'Revive Our Ocean' has launched the Revive Our Ocean Collective, a network of local leaders and organisations who have pioneered successful community-led marine conservation.

Financing and Ending Destructive Fishing Practices

- A major feature of 'Revive Our Ocean' is its **upcoming microfinance program that will offer loans and grants to communities wishing to establish or expand MPAs.**
- Ending destructive practices like **bottom trawling is another top priority**.
  - **Bottom trawling not only devastates marine habitats but also leads to an annual economic loss of €11 billion in Europe alone.**

Blue Category' for Essential Environmental Services

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The **Central Pollution Control Board (CPCB)** has rolled out a **revised classification of industries, introducing a new "Blue Category"** specifically for **industries engaged in essential environmental services.**

More on News

- This move is aimed at **recognising and incentivising utilities involved in waste management and environmental protection**, even if they typically exhibit a high Pollution Index (PI).

New Category for Essential Environmental Services

- In letters sent to **state pollution control boards (SPCBs)** in February and again on March 25, CPCB directed the **adoption of the revised industrial classification,** which includes a new category termed the Blue Category sector.
- This category encompasses **industries providing Essential Environmental Services (EES)—such as landfill operators, biomining agencies, waste-to-energy plants, and select compressed biogas (CBG) plants.**

Scope of the Blue Category

- According to CPCB, **this category will include any facility that helps manage environmental concerns** stemming from household and domestic waste, which would otherwise contribute significantly to littering.
- While **waste-to-energy plants typically score high** on the Pollution Index (PI of 97.6, applicable for the Red Category), **they have been reclassified into the Blue Category**—likely due to the crucial services they offer in urban waste management.
- **Select CBG plants using municipal solid waste, agro-residue, energy crops, grasses, or weeds as feedstock are also considered** under the Blue Category.
  - However, CBG plants processing industrial or process waste will remain in the Red Category due to their greater pollution potential.

Pollution Index-Based Classification Remains

- The revised industrial categorisation continues to be based on the Pollution Index, as follows:
  - **Red Category:** PI > 80
  - **Orange Category:** 55 ≤ PI < 80
  - **Green Category:** 25 ≤ PI < 55
  - **White Category:** PI < 25 (non-polluting)
  - **Blue Category:** Essential environmental services, regardless of PI
- Despite the high pollution potential of some Blue Category industries, CPCB emphasises that they **must still comply with all prescribed environmental norms and regulations.**
  - The Pollution Index for these industries will continue to be calculated as per the standard methodology.

Incentives for Environmental Compliance

- Industries under the Blue Category that demonstrate effective implementation of environmental management measures—validated by a designated committee—will be **eligible for incentives.**

- These primarily include **extended validity of permits, particularly the Consent to Operate.**

- The validity for **Red Category industries remains at five years,** while **Blue Category industries will receive a two-year extension** beyond their applicable PI-based term, as a form of regulatory encouragement.

Policy Shifts in Environmental Approvals

- This development aligns with recent policy reforms.
- Last year, the Union government revised environmental approval processes to remove dual compliance.
- Industries that have received Environmental Clearance (EC) are no longer required to obtain separate Consent to Establish (CTE).
- Additionally, industries classified under the White Category, being non-polluting, are exempt from obtaining both CTE and CTO from state boards.

Outstanding Questions Remain

- Despite the policy update, CPCB has not responded to queries regarding the **impact of the new classification on pollution regulation,** the rationale for placing high-PI waste-to-energy plants in the Blue Category, or details of any industries moved out of the Red Category.
- Nonetheless, the introduction of the Blue Category appears to mark a more pragmatic approach to environmental governance—**acknowledging the indispensable role of certain high-impact industries while promoting compliance through regulatory incentives.**

Emission Reduction Targets for Energy-Guzzling Companies

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

In a significant move to accelerate **industrial decarbonisation,** India has proposed a **comprehensive compliance mechanism to curb greenhouse gas (GHG) emissions** across **four of its most carbon-intensive sectors — aluminium, cement, chlor-alkali, and pulp & paper.**

More on News

- The **draft rules,** part of India's **evolving Carbon Credit Trading Scheme (CCTS), 2023**, were recently **notified by the Ministry of Environment, Forest and Climate Change (MoEFCC) as the Greenhouse Gas Emission Intensity (GEI) Target Rules, 2025.**
- The MoEFCC has opened a **60-day window for public consultation and stakeholder feedback** on the draft rules.

GREY HUES

Energy-intensive industrial sectors and their GHG emissions

Sector	Production (mt)*	GHG emissions (% of total emissions)
Iron and steel	358	12
Aluminium	11.25	8
Cement	391	7
Chemicals and petrochemicals	57.33	4
Textile	16.95	2
Pulp and paper	22.43	1.1
Fertiliser	51.92	1

*Production as of 2021-22 Source: Multiple sources, including NITI Aayog, JMK Research, EAI, and CEEW

What the GEI Target Rules Aim to Achieve

- **NDCs:** The primary objective of the proposed GEI Target Rules is to help India **fulfill its Nationally Determined Contributions (NDCs) under the Paris Agreement,** by **reducing emissions through targeted interventions in high-emission industries.**
  - The rules aim to encourage the adoption of **sustainable, low-carbon technologies and create a compliance-based market mechanism** to track and trade emission reductions.
- **Sector Specific Targets: Over 130 industrial units,** including major corporations like Vedanta, Hindalco, Nalco, UltraTech, ACC, Ambuja, Dalmia, and JSW Cement, have been assigned **sector-specific Emission Intensity Targets (EITs).**
  - These targets will be **measured in tonnes of CO_2 equivalent per tonne of production (tCO_2/tonne)** and will be applicable for the financial years 2025–26 and 2026–27, using FY 2023–24 as the baseline year.

Sector-Wise Emission Targets and Compliance

- Under the framework, the **Bureau of Energy Efficiency (BEE)** will oversee the calculation and implementation of these EITs.
- **Obligated entities must meet their assigned reduction targets** or face compliance actions. For example:
  - Vedanta Limited's Smelter-II in Odisha must cut emissions from 13.4927 tCO_2 in FY24 to 12.8259 tCO_2 by FY27.

- Nalco's Angul complex must reduce from 17.3505 tCO_2 to 16.2479 tCO_2 during the same period.
- Other firms like JK Cement, Dalmia Cement, and DCM Shriram's chlor-alkali plant have similarly been issued targeted reductions.

Non-Compliance, Penalties, and Carbon Credit Trading

- Entities failing to meet their emission intensity targets **will need to purchase carbon credit certificates or pay an environmental compensation (EC) penalty** to the Central Pollution Control Board (CPCB).
- The **penalty is set at twice the average market price of carbon credits** for the respective compliance year and must be paid within 90 days.
- **Funds collected** through EC will be **reinvested under the CCTS**, guided by the National Steering Committee for the Indian Carbon Market and subject to central government approval.

GOALS FOR LEADING PLAYERS

tC02: tonnes of carbon dioxide
Source: MoEFCC's draft notification

Company	Plant	Target (tC02) FY24	FY27
Nalco	Smelter & power complex (Odisha)	17.3505	16.2479
Vedanta	Smelter II (Odisha)	13.4927	12.8259
DCM Shriram Consolidated	Chlor-alkali (Rajasthan)	1.9371	1.8052
Dalmia Cement (Bharat)	Kadapa (AP)	0.5173	0.5083
JK Cement	Bagalkot (Karnataka)	0.4455	0.4391

Encouraging a Transparent and Stable Carbon Market

- Experts view the initiative as a crucial step toward **building a robust carbon market in India.**
- Parth Kumar, programme manager at the **Centre for Science and Environment**, emphasised the importance of:
  - Setting ambitious yet realistic emission targets.
  - Ensuring transparency and efficiency in monitoring, reporting, and verification (MRV) processes.
  - Enforcing strict penalties.
  - Establishing a floor price for carbon credits.
  - Avoiding oversupply of credits to maintain market stability.
- Kumar stressed that the **design and enforcement of these mechanisms will be key to determining the success of India's carbon market and its ability to meet climate goals.**

India's Climate Commitment and Industrial Decarbonisation

- India's broader climate policy is aligned with the **United Nations Framework Convention on Climate Change (UNFCCC)** and **Article 6 of the Paris Agreement.**

Other Initiatives

LeadIT (Leadership Group for Industry Transition): Launched in 2019 by **India and Sweden** at the UN Climate Action Summit, LeadIT brings together governments, industries, and think tanks to promote low-carbon industrial transitions.

Science-Based Targets Initiative (SBTi): Companies like Mahindra Group, Wipro, and Infosys have set SBTi-validated emission reduction targets.

RE100 (Renewable Energy Commitment): Firms such as Tata Motors, Godrej, and Tech Mahindra pledged to shift to 100% renewable energy.

Carbon Disclosure Project (CDP): Indian firms like ITC, Reliance, and HUL disclose emissions and climate strategies through CDP.

Industrial Energy Efficiency Programs (PAT Scheme): The Perform, Achieve, and Trade (PAT) scheme under BEE has helped industries reduce energy consumption by 13 million tonnes of oil equivalent (MTOE) since 2012.

First Movers Coalition (FMC): A **World Economic Forum (WEF)** initiative where companies commit to buying low-carbon steel, cement, and aluminum.

Green Hydrogen Mission: Private players like Reliance, Adani, and ACME are investing in green hydrogen to decarbonize industries.

Global Climate Finance (GCF & IFC): The **International Finance Corporation (IFC) and Green Climate Fund (GCF)** provide funding for clean industrial transitions in India.

- The country has **pledged to reduce the emission intensity of its GDP by 45% by 2030, relative to 2005 levels.**
- The **CCTS is a cornerstone of this strategy,** aiming to link compliance-based reduction efforts with a national carbon trading platform, expanding on the earlier **Perform, Achieve and Trade (PAT) scheme.**

India Becomes Third-Largest Producer of Wind and Solar Electricity

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment. Infrastructure: Energy, Ports, Roads, Airports, Railways etc.*

Context:

In **2024**, India overtook **Germany** to become the **world's third-largest producer** of electricity from **wind and solar energy**. The sixth edition of **Ember's Global Electricity Review** reported that wind and solar energy together generated **15% of global electricity**, with India contributing **10%** of that total.

More on News

- Solar power generation globally doubled in just three years, reaching **6.9%** of the electricity mix.
- **Solar** remains the **fastest-growing power source** for the **20th year in a row**.

Global and Indian Energy Trends

- **Low-carbon sources** (including renewables and nuclear power) accounted for **40.9%** of global electricity in 2024, marking the first time since the **1940s** this threshold was crossed.
- In India, **clean sources** (solar, wind, hydropower, and nuclear) provided **22%** of electricity generation in 2024.
  - **Hydropower** contributed the most at **8%**, while **wind and solar** together contributed **10%**.

Growth in Electricity Demand

- Electricity demand globally grew due to rising consumption from **AI, data centers, electric vehicles, and heat pumps**, contributing to a **0.7% increase in global electricity demand in 2024**.
- In India, **heatwaves** were responsible for about **one-third of the rise in power demand during the 2024 summer**, with air conditioning usage significantly contributing to the surge.
- India's electricity **demand grew by 5% in 2024**, with clean generation meeting **33%** of the increase, while coal met **64%** of the demand rise (significantly lower than in 2023, when coal met 91%).

Renewable Energy Growth

- **Global renewable energy generation** set a record, adding **858 terawatt hours (TWh)** in 2024, which is **49% more** than the previous record in 2022.
- **Solar power** was the largest source of new electricity for the third consecutive year, adding **474 TWh** in 2024.
- Over the last **three years**, global solar generation has **doubled**, now representing **6.9%** of the global electricity mix.

India's Solar Power Expansion

- Solar contributed **7%** to India's electricity generation in 2024, doubling since 2021.
- India added **24 gigawatts (GW)** of solar capacity in **2024**, more than **double** the amount added in **2023**.
- India became the **third-largest solar market** globally after **China** (1,826 TWh) and the **US** (757 TWh).
- The country recorded the **fourth-largest increase** in solar generation worldwide, adding **20 TWh**.

Significance of Solar Power

- **Phil MacDonald**, Managing Director of Ember, stated that **solar power** has become a central driver of the global energy transition, particularly when paired with **battery storage**.
- Solar is described as the **fastest-growing** and **largest source of new electricity**, which is crucial in meeting the increasing global demand for power.

Challenges and Future Goals

- India is facing the challenge of ensuring that its clean energy generation grows rapidly enough to meet its rising power demand.
- India's **climate commitments** aim for **50%** of its installed electric power capacity from **non-fossil fuel sources** by **2030**.
- The country also set a goal of achieving **500 GW** of non-fossil fuel capacity by **2030**, although the **Ember report** noted that achieving this goal requires a **20% annual increase** in funding for renewable energy deployment.

Regional and Global Impacts

- **Aditya Lolla**, Asia Programme Director at Ember, highlighted that Asia's **clean energy transition** is accelerating, driven by record growth in **solar** and other **renewable sources**.
- The clean energy market's expansion is vital for ensuring **energy security**, **economic resilience**, and providing **emerging countries** with the benefits of the global clean energy economy.

India's Progress as a "Solar Superpower"

- India has made significant strides in adopting renewables, but as the demand for energy rises, maintaining rapid growth in clean energy is critical to meeting future needs.
- UN climate change chief **Simon Stiell** referred to India as a "solar superpower," emphasising that fully embracing clean energy would fuel India's **economic rise**.

Plastic Parks Scheme

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The Government of India, through the **Department of Chemicals and Petro-Chemicals,** is implementing the **Scheme for Setting up of Plastic Parks** under the umbrella of the **New Scheme of Petrochemicals.**

More on News

- This initiative aims to **establish modern, need-based Plastic Parks** equipped with **state-of-the-art infrastructure and shared facilities.**

- These parks are **designed to promote cluster-based development,** consolidate the domestic plastic processing industry, and enhance investment, production, exports, and employment in the sector.

What Are Plastic Parks?

- Plastic Parks are **specialised industrial zones dedicated to plastic-related businesses.**
- These parks **aim to create an ecosystem that supports downstream plastic processing industries** by offering a range of shared amenities and infrastructure.
- They **serve as hubs to attract investments,** increase value addition, generate employment, and ensure sustainable practices through waste management and recycling.
- So far, the **government has approved 10 Plastic Parks across various states.**
  - Each project is eligible for **financial support from the central government—up to 50% of the total project cost, with a ceiling of ₹40 crore per park.**

Need for Plastic Parks

- **India ranked 12th in global plastic exports in 2022,** a significant leap from its 2014 standing.
- The **value of exports rose from USD 8.2 million thousand in 2014 to USD 27 million thousand in 2022,** reflecting substantial growth spurred by policy support and infrastructure development.
- Despite this progress, **India's plastics industry remains fragmented, dominated by small and medium enterprises** lacking scale and modern capabilities.
- Recognising this gap, **the government introduced the Plastic Parks scheme** to consolidate capacities, improve competitiveness, and foster innovation within a collaborative industrial ecosystem.

Objectives of the Scheme

- **Enhancing Competitiveness:** Improve polymer absorption and value addition through research-driven and modern practices.
- **Boosting Investment and Exports:** Expand capacity, create quality infrastructure, and support production growth to stimulate exports.
- **Sustainable Development:** Promote eco-friendly practices like recycling, waste treatment, and circular economy models.
- **Cluster-Based Development:** Leverage shared infrastructure and resources to lower costs and drive economies of scale.

Process of Establishing a Plastic Park

- The journey begins with **state governments submitting preliminary proposals** outlining the project location, financial details, and cost estimates.
- Once the **Scheme Steering Committee** grants in-principle approval, a **Detailed Project Report (DPR)** is prepared and reviewed for final clearance.
  - For example, in November 2020, proposals were invited from several states.
  - Based on evaluations by an expert committee, new Plastic Parks were approved in **Gorakhpur, Uttar Pradesh (July 2022), and Ganjimutt, Karnataka (January 2022).**
- Once approved, the **implementation is handled by Special Purpose Vehicles (SPVs)** set up by state governments or industrial development corporations.
  - These agencies facilitate land allocation, offer tax incentives, conduct outreach programs, and help attract industrial units to the park.

Infrastructure and Sustainability Focus

- Each Plastic Park is designed with **common infrastructure to support both industrial growth and environmental sustainability.**
- Facilities include **effluent treatment plants, solid and hazardous waste management systems,** plastic recycling units, and incinerators. Several parks have also developed in-house recycling sheds to manage plastic waste on-site.

Supporting Measures by the Government

- **Centres of Excellence (CoEs):** Thirteen CoEs have been established in reputed national institutes to drive R&D in areas like sustainable polymers, advanced materials, and wastewater management in petrochemical industries.
- **Skill Development:** The **Central Institute of Petrochemical Engineering and Technology (CIPET)** runs various courses to skill the workforce in plastic processing technologies, helping bridge the talent gap.

Embracing Environmental Sustainability

- **Extended Producer Responsibility (EPR):** Manufacturers are required to meet targets for reuse, recycling, and use of recycled content in packaging.
- **Ban on Single-Use Plastics:** Certain items have been banned to curb pollution.
- **Circular Economy Promotion:** The government supports exhibitions and conferences that showcase recycling and upcycling technologies, along with products made from recycled materials.
- **International Engagement:** India actively participates in global sustainability forums like the WTO, UNEP, and ISO to ensure compliance with international standards and promote sustainable practices.

World's First Particulate Matter Trading Scheme in Gujarat

Sub Topic: *Conservation, environmental pollution and degradation, environmental impact assessment.*

Context:

The city of Surat in Gujarat became the world's first to implement a market-based approach to control **particulate matter emissions**. Launched in **2019**, the **Surat Emissions Trading Scheme (ETS)** has significantly curbed air pollution while reducing compliance costs for participating industries, according to a new study published in *The Quarterly Journal of Economics*.

More on News

- The initiative is the result of a collaboration between the **Gujarat Pollution Control Board (GPCB)** and researchers from the **University of Chicago**, **Yale University**, and the **Abdul Latif Jameel Poverty Action Lab (J-PAL)**.
- Surat was chosen due to its **industrial profile**, where industry contributes **~1/3 of ambient PM pollution**.

How the Surat ETS Works?

- The ETS operates on a **cap-and-trade** model, already used globally for greenhouse gases in **Europe** and **China**. In this system:
  - A **cap** is placed on total permissible emissions across all participating plants.
  - Each plant is allocated permits, with the flexibility to **buy or sell permits** based on their emissions.
  - Non-compliant plants—those exceeding their caps without sufficient permits—face fines.
- The goal is to **create economic incentives** for industries to reduce pollution: plants that emit less can **profit from selling permits**, while those exceeding limits must **purchase additional permits or pay penalties**.

Implementation and Impact

- The market, hosted on the **National Commodities and Derivatives Exchange e-Markets Limited (NeML)** platform, began with a cap of **280 tons per month**, based on theoretical maximum emissions.
- After continuous real-time monitoring, the cap was revised to **170 tons per month**, aligning with actual emissions data.
- Between **April 2019 and March 2021**, a **randomised controlled trial (RCT)** studied **317 industrial plants**, with **162 plants** participating in the emissions market and **155 plants** operating under traditional pollution regulations. The participating units were predominantly from **Surat's textile sector**, which is a major contributor to the city's air pollution.
- Emission reduction in absolute terms: from **3.6 kg/hour** to **2.88 kg/hour**, i.e., a reduction of **0.72 kg/hour**.

Key Findings from the Study

- **Pollution Reduction**: ETS plants reduced **particulate matter emissions by 20–30%**.
- **Compliance**: Participating plants had valid permits **99% of the time**.
- **Cost Savings**: These plants **reduced their pollution control costs by 11%**, making compliance more affordable.
- In contrast, non-participating plants failed to meet pollution norms for **nearly one-third** of the study duration.

Real-Time Monitoring and Mock Trials

- To ensure transparency and accountability, all participating plants were fitted with **continuous emissions monitoring**

systems (CEMS) before the scheme's launch. These systems recorded real-time emissions data, which was crucial for setting accurate caps and ensuring compliance.

- Prior to the full rollout, **mock trading trials** were held to familiarise industries with the trading platform and compliance requirements.

Permit Allocation and Auctions

- **The GPCB allocated:**
  - **80% of the emissions cap as free permits**, distributed proportionally based on each plant's emissions potential (e.g., boiler size).
  - The remaining **20% of permits were auctioned weekly**.
- Plants were fined if they failed to obtain enough permits to match their emissions, ensuring enforcement and market integrity.

Broader Implications

- The Surat ETS proves that **pollution markets can work in developing countries**, delivering **environmental and economic benefits** simultaneously.
- Could serve as a **model for replication** in other cities facing industrial air pollution challenges.
- Demonstrates how **scientific policy design**, **technology-backed enforcement**, and **economic incentives** can come together for sustainable development.

Mains

The Other Space Race: Geopolitics and Governance of Satellite Internet

Sub Topic: *Space Technology, Satellite, Internet*

Context:

Satellite internet is emerging as a transformative technology in the global digital infrastructure landscape. India's **strategic partnerships** with **SpaceX's Starlink** through **Airtel** and **Jio** represent a significant shift in digital geopolitics and technological alignment. It reflects broader tensions between **technological pragmatism**, **national sovereignty**, and **geopolitical alignment**, particularly in the Indo-Pacific.

About India America Starlink's Deal and Its Strategic Implications

- Starlink, being of **American origin**, introduces **geopolitical sensitivities** in India's communication infrastructure.
- Key **reasons for choosing Starlink**:
  - **First-mover advantage** with ~7,000 operational satellites.
  - Lack of comparable indigenous alternatives.
  - Alignment with **democratic partners** in the **Indo-Pacific**.
- **Strategic risks**:
  - **National security** concerns from foreign ownership of critical infrastructure.
  - **Dependency on a private foreign entity** for digital backbone.
  - **Precedent of influence**: Starlink's service restriction in Ukraine (2022) signals potential **foreign control over national affairs**.
- **Missed opportunity** for indigenous development or alternative partnerships (e.g., **BSNL involvement**) raises concern.

Satellite Internet in India: Bridging the Digital Divide

- A significant portion of India, especially **rural and remote areas**, still lacks **fiber optic** and **cellular tower infrastructure**.
- Satellite internet offers an opportunity to **bypass traditional ground-based infrastructure**, delivering high-speed internet directly from space.
- Benefits for **domestic telecom providers**:
  - **Economic**: Reduced infrastructure deployment costs.
  - **Strategic**: Expansion of footprint in untapped markets.
- Benefits for **SpaceX**:
  - Access to a **massive consumer market**.
  - Entry via **regulatory navigation** through Indian partnerships.

India's Strategic Position: Balancing Digital Sovereignty and Pragmatism

- India aims to achieve **Digital Sovereignty**—high economic utility with high geopolitical control.
- **ISRO's indigenous efforts** are strategically valuable but currently lack **commercial viability** and scale.
- India's current model with Starlink reflects **"Managed Dependency"**:
  - Partnerships with **Airtel and Jio** offer a buffer.
  - Possibility of **technology transfer clauses** and **data localisation requirements**.
  - A middle ground between **autonomy** and **foreign reliance**.
- **BSNL's absence** in this model is notable:
  - Its inclusion could bring **government oversight**.
  - **Strategic rural outreach** potential remains untapped due to financial constraints.

Global Governance: Managing the Satellite Internet Commons

- The proliferation of satellite constellations introduces **transnational challenges**:
  - **Orbital debris** management.
  - **Space traffic regulation**.
  - **Cross-border data jurisdiction and legal frameworks**.
- Current governance mechanisms are **fragmented** and **insufficient**.
- Lack of international coordination may result in a **"tragedy of the orbital commons"**—overcrowding, collisions, and legal disputes.
- **Strategic rivalries** further complicate the establishment of a cohesive global framework.

Challenges in Implementing Satellite Internet in India

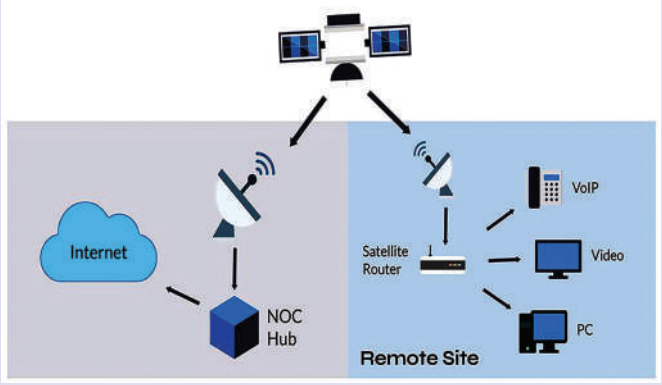
- **Affordability** remains a primary concern:
  - Without **tiered pricing models** and **affordable packages**, rural and low-income users may remain excluded.
  - Requires **frugal innovation** to tailor solutions to the **bottom of the pyramid**.
- **Commercial viability vs accessibility**:
  - High costs risk turning a transformative technology into an **elitist service**.
- **Need for public support**:
  - **Government subsidies** may be essential initially.
  - However, sustainability without ongoing state support is crucial.

Conclusion

- Orbital infrastructure has become as **strategic** as terrestrial networks.
- India must carefully balance:
  - **Technological pragmatism** with **strategic autonomy**.
  - **Commercial benefits** with **national security** and **sovereignty**.
  - **Global connectivity** with **equitable domestic access**.
- The path forward demands a mix of **indigenous innovation**, **strategic partnerships**, and **inclusive governance** to ensure that the promise of satellite internet does not create a new **digital divide**, but rather bridges existing ones.

Working of Satellite Internet

Satellite internet is a crucial alternative to terrestrial internet services, especially in **remote and underserved areas**. It offers a way to provide internet access where traditional fiber-optic or cellular infrastructure is unfeasible. This article explores the functioning, technical components, advantages, and limitations of satellite internet systems.



- Satellite internet relies on **geostationary satellites** located **22,300 miles** above the Earth's equator.
- A **satellite dish** on the ground communicates with the satellite, which in turn links to a **Network Operations Center (NOC)**.
- The **NOC**, connected to the broader internet, acts as the **gateway** between the user and the internet.
- **Data transmission involves four legs:**
  - From user terminal to satellite
  - From satellite to NOC
  - From NOC to satellite
  - From satellite back to user terminal

Geostationary Satellites: The Core of the System

- A **geostationary satellite** appears stationary from the Earth due to synchrony with Earth's rotation (24-hour orbit).
- Located above the **equator (zero latitude)** at a fixed **longitude**, enabling consistent communication.
- Satellite examples: *Galaxy 18*, *AMC-4*.

Frequency Bands: The Ku-Band and Alternatives

- Satellite internet uses the **Ku-band**:
  - **Uplink (transmit):** 14,000–14,500 MHz
  - **Downlink (receive):** 11,700–12,750 MHz
- Other frequency bands:
  - **L-band**: Used for **IoT**, **satellite phones**
  - **C-band**: Requires **large dishes**
  - **Ka-band**: Allows **smaller dish sizes** with high data capacity

The PEN-Plus Approach

Sub Topic: *Biotechnology, Health, Non-Communicable Diseases*

Context:

The **PEN-Plus approach** has expanded access to care for **severe non-communicable diseases (NCDs)** in **20 African countries** over the past four years.

More on News

A new report titled **"Understanding the PEN-Plus approach to care: Expanding access to care for severe non-communicable diseases in the WHO African Region"** was released on **April 14, 2025**, by the **World Health Organisation (WHO) Africa** with support from the **Leona M. and Harry B. Helmsley Charitable Trust**.

The Growing Burden of NCDs in Africa

- **NCD-related deaths** surged in the **WHO African Region**, with over **2.8 million deaths** recorded in 2019 alone—an average of more than **7,900 deaths per day**.
- NCDs accounted for **37% of all deaths** in 2019, up from **24% in 2000**, signalling a sharp rise in the disease burden.
- The total number of deaths in the region declined from **8.7 million in 2000** to **7.8 million in 2019**, but NCDs have become a larger contributor to this mortality.

The PEN-Plus Model of Care

Most Prevalent Severe NCDs in Africa

- Common severe NCDs affecting people in Africa include:
- **Sickle-cell disease**
- **Type 1 and insulin-dependent Type 2 diabetes**
- **Rheumatic heart disease**
- **Severe hypertension**
- **Moderate to severe and persistent asthma**

- It was developed as an extension of the **WHO's Package of Essential Non-communicable Disease (PEN)** interventions, which focuses on managing common NCDs at the **primary healthcare level**.
- The **PEN-Plus model** aims to provide comprehensive care for **severe NCDs** by training and equipping **nurses and clinical officers** to deliver essential services, such as:
  - **Diagnosis**
  - **Symptom management**
  - **Psychosocial support**

Challenges in Access to Care

- In many low-income countries, **severe NCD care** is **only available** at **referral hospitals** in **major cities**, making it **inaccessible and unaffordable** for **rural populations**.
- This lack of access results in **premature deaths** due to untreated severe NCDs.
  - **Example**: **Children with type 1 diabetes** in sub-Saharan Africa have a **life expectancy of less than one year** after diagnosis due to the lack of treatment.

Impact of PEN-Plus in Africa

- The **PEN-Plus model** was originally developed in **Rwanda** to provide care for individuals living in extreme poverty, addressing their need for diagnosis and care.
- The model has shown promising results in **Liberia, Malawi, and Rwanda**, where it has significantly increased access to treatment for **severe, chronic NCDs**.

Significance

- PEN-Plus is a critical initiative to ensure that **the poorest billion** of the world's population, especially those in rural, under-resourced areas, have access to **life-saving chronic care** for severe NCDs.
- Integrating care at the first-level hospitals **improves health outcomes** and **reduces preventable deaths** from conditions like **type 1 diabetes** and **rheumatic heart disease** in underserved populations.

Key Statistics and Achievements

- **15,000+ people** have received treatment for severe NCDs in **PEN-Plus implementing countries** as of **January 2025**.
- **Malawi** has made significant strides with the **national scale-up** of PEN-Plus, training **440+ clinicians and nurses**.
- **Six secondary-level health facilities** in Malawi are providing **PEN-Plus care** to over **300 patients** living with severe NCDs.

Future Directions and Urgency for Action

- The report emphasises the need for **sustained investment** and **collaboration** to expand **PEN-Plus coverage** across the **WHO African Region**.
- It calls for continued prioritisation of **NCDs on the global health agenda**, and for creating **sustainable health systems** that ensure better outcomes for underserved populations.
- The **PEN-Plus approach** serves as a critical step in addressing **severe NCDs** in **low-resource settings** and creating **equitable access to healthcare**.

Prelims

Type 5 Diabetes

Sub Topic: *Biotechnology, Health, Non-Communicable Diseases*

Context:

Type 5 diabetes was officially classified as a distinct form of diabetes by the **International Diabetes Federation (IDF)** at the **75th Diabetes World Congress** in **Bangkok (April 7, 2025)**.

More on News

- **IDF President Peter Schwarz** called it a "historic shift," noting it affects **25 million people globally** and has long been **overlooked or misdiagnosed**.
- It currently affects an **estimated 25 million people globally**, predominantly in **the Global South**, including **India, Sri Lanka, Bangladesh, Uganda, Ethiopia, Rwanda, and Korea**.

What is Type 5 Diabetes?

- Type 5 diabetes primarily affects **lean and malnourished teenagers and young adults** in **low- and middle-income countries**.
- It is caused by **malnutrition-induced reduction in insulin production**.
- This form of diabetes involves **abnormal functioning of pancreatic beta cells**, leading to **severely reduced insulin secretion**.
- **Unlike Type 2 diabetes**, which is characterised by **insulin resistance**, Type 5 is due to insufficient insulin production.

Recognition and Historical Background

- It was first reported in **Jamaica in 1955** as **'J-type diabetes'**.
- Classified by the **World Health Organisation (WHO)** in **1985** as **"malnutrition-related diabetes mellitus"**.
- The WHO dropped the classification in **1999** due to lack of conclusive evidence linking malnutrition to diabetes.
- A 2023 **meta-analysis in *The Lancet Diabetes & Endocrinology*** established a clear link between **malnutrition and pancreatic dysfunction**.
- **Reclassified as "Type 5 diabetes"** by the IDF in **January 2025**, with **formal endorsement in April 2025**.

Cause: Malnutrition from the Womb

- Referred to as **SIDD** (Severe Insulin-Deficient Diabetes).
- **Inadequate nutrition in utero** can impair fetal development, including the pancreas, increasing the risk of diabetes in later life. A **2022 WHO report** found that **200 million children under 5** in low-income countries suffer from **stunting**, increasing diabetes risk.
- **Dr C S Yajnik** (Director, Diabetes Unit, KEM Hospital Pune) explains:
  - Undernutrition in the womb followed by **continued undernutrition after birth** leads to **Type 5 diabetes**.
  - In contrast, undernutrition followed by **excessive weight gain** later in life is linked to **Type 2 diabetes**.
- Historical factors like **colonisation, famine, and hard labour** contributed to widespread undernutrition in several developing countries.

Key Characteristics of Type 5 Diabetes

- They exhibit a **significantly lower Body Mass Index (BMI)** — typically **less than 18.5 kg/m²**.
- **Insulin secretion**: Reduced by up to **70%** compared to healthy individuals.
- **Fat percentage**: Only **10-12%**, compared to **20-25%** in healthy adults.
- **Dietary deficiencies**: Low intake of **proteins**, **fibre**, **zinc**, and **vitamin A**.
- **Symptoms**: Fatigue, significant weight loss, frequent infections.
- **No autoimmune or genetic cause** — makes it distinct from Type 1 or Type 2.

Next Steps for Diagnosis and Treatment

- A **Type 5 Diabetes Working Group** is actively working to study diverse populations over the next **two years**, especially in **low-income, low-resource** settings.
- Focuses on **reversing malnutrition**: A **high-protein diet** (legumes, fish) is essential for weight gain and glycemic control. Depending on BMI and activity levels, **adequate carbohydrates and fats** are also needed for **healthy weight gain**.
- **Metformin or low-dose insulin** is prescribed based on glucose levels—**not high-dose insulin**, which risks hypoglycemia.

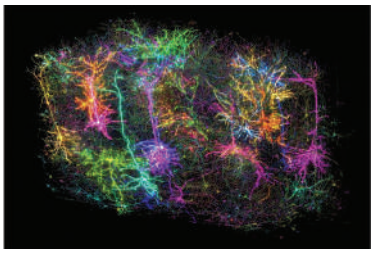
Mouse Brain Mapping

Sub Topics: *Biotechnology, Genome Mapping*

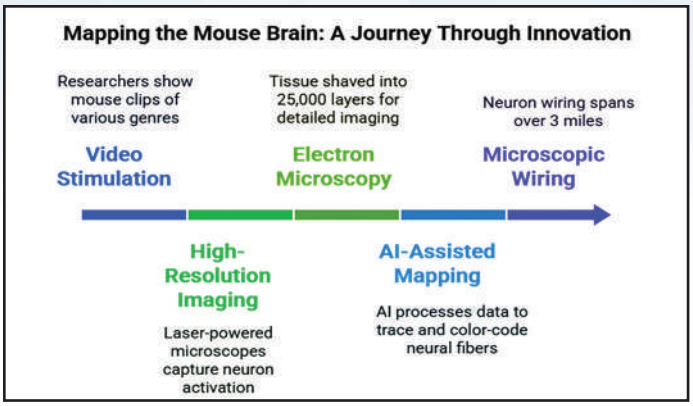
Context:

Scientists have created the largest functional map of a brain to date, identifying and **mapping 84,000 neurons in a mouse brain**, capturing how these neurons fire and communicate via synapses.

Key Findings



- **Mapping the Wiring:** Researchers traced the wiring of these neurons across **500 million junctions** called **synapses**, a crucial step toward understanding brain connectivity.
- **3D Brain Reconstruction:** The data was assembled into a 3D reconstruction, with different brain circuitry highlighted using various colours, offering an unprecedented view of neural networks.
- **Project Significance:** This study marks a significant advancement in neuroscience, contributing to understanding the complex networks that enable functions such as **thinking, feeling, moving,** and **perceiving**.



- **Publicly Accessible Data:** The data, **published in *Nature***, is available for scientists and the general public to explore, enabling further research and providing a glimpse into the complexity of the brain.

Applications and Future Impact

- **Understanding Neural Networks:** The study provides insight into how neurons interact and communicate, potentially offering answers to **neurological disorders like Alzheimer's and autism**.
- **Path to Brain Disease Treatments:** This mapping could help scientists identify abnormal neural patterns linked to brain diseases, providing a foundation for future treatments.
- **Comparable to Human Genome Project:** Researchers compare this work to the **Human Genome Project**, suggesting that it could eventually lead to **new gene-based treatments for neurological conditions**.
- **Global Research Collaboration:** Over **150 scientists from institutions** such as the **Allen Institute, Baylor College of Medicine,** and **Princeton University** collaborated on this project, marking a global effort to explore the brain's complexity.

India Completes First Phase of Genome Mapping

Sub Topic: *Biotechnology, Genome Mapping*

Context:

India has successfully completed the first phase of its ambitious **Genome India Project (GIP),** creating **a rich genetic database that is now ready for use.**

More on News

- The project, which has **sequenced the entire genomes of 10,000 individuals from 83 diverse population groups,** promises to **revolutionise healthcare and shed light on the country's genetic and evolutionary history.**
- **Led by over 100 scientists across 20 Indian academic and research institutions,** the GIP is **India's largest and most comprehensive effort to catalog its population's genetic makeup.**
- The initial findings have been published in **Nature Genetics,** with further analysis and expanded results expected next year.

Human Genome Project (HGP): Launched in 1990 and completed in 2003, this international effort aimed to sequence the entire human genome. It involved researchers from the **U.S., U.K., Japan, France, Germany, and China,** costing $2.7 billion. The HGP mapped **~92% of the human genome by 2003, with refinements completed by 2022.**

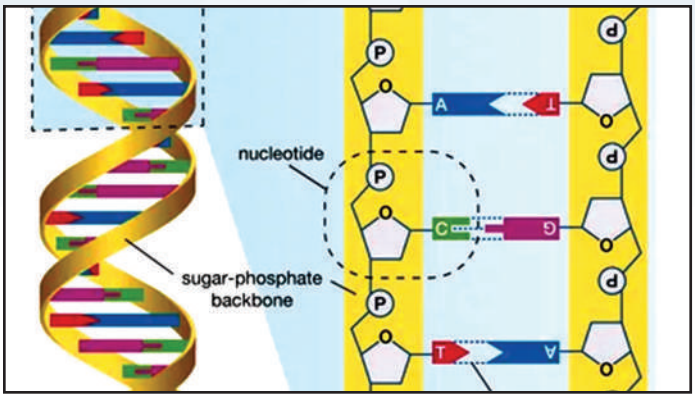
Genome India Project (GIP): Initiated in 2020 by India's **Department of Biotechnology,** GIP focuses on sequencing 10,000 Indian genomes to create a population-specific genetic reference. By 2024, it successfully sequenced 10,000 genomes from 99 ethnic groups, stored as an 8-petabyte dataset at the Indian Biological Data Centre.

Gateway to Personalised Medicine and Targeted Treatments

- **Healthcare:** The database generated through GIP is poised to enable **breakthroughs in healthcare by paving the way for personalised medicine and more accurate, faster diagnostics.**
  - By understanding the unique genetic variations that exist across India's population, scientists and healthcare providers can tailor treatments to individual genetic profiles rather than rely on general prescriptions.
- **Three Billion Nucleotide:** The full genome of an individual consists of approximately three billion nucleotide molecules — **adenine (A), thymine (T), cytosine (C), and guanine (G)** — arranged in a specific sequence.
  - While 99.9% of this sequence is identical across all humans, it is the 0.1% variation — about 3 to 4 million nucleotides — that makes each person unique in physical traits, behaviour, and health predispositions.
- **Revealing Adaptations:** These variations can also reveal how different communities have genetically **adapted to their environments over centuries**.
  - Most differences are harmless, but a small percentage—about 1–2%—can significantly affect a person's traits or susceptibility to diseases, which makes them especially important for medical research.

Building the GIP Database

- **Blood Samples:** The genome sequences in the GIP were created **using blood samples, specifically focusing on the "germline" DNA** — the genetic information inherited from one's parents.



- This type of DNA, collected from white blood cells, helps preserve the original genetic code and is less likely to be altered during cell division.

- **Knowing Health Conditions:** Understanding an individual's germline sequence can indicate their risk of developing specific health conditions or explain **why certain treatments might be ineffective.**
  - This data can lead to **more personalised, effective therapies.**
  - Additionally, if patterns in the consequential genetic segments are shared across a population group, it may **reveal a collective predisposition to diseases,** such as diabetes, which is highly prevalent in India.
- **Specific Drugs:** Such findings can lead to the development of population-specific drugs and more **targeted health interventions,** especially for rare genetic disorders found primarily among Indian communities.

Tracing Ancestry and Evolution Through DNA

- **Evolutionary History:** Beyond healthcare, the GIP also holds immense potential for unravelling the evolutionary history of India's population groups.
  - Since germline DNA reflects inherited genetic traits, it can be used to **trace ancestry, track migration patterns, and study how communities intermingled or adapted to different climates and geographies.**
- **Identity and Origins:** By comparing genetic data across generations and across ethnic, linguistic, and geographical groups, scientists can piece together how populations moved, mixed, and evolved — offering insight into the deeper question of human identity and origins.

India's Answer to the Human Genome Project

- The **Genome India Project is India's counterpart to the global Human Genome Project,** which began over two decades ago.
- However, the **original global initiative lacked sufficient representation from Indian populations.**
- Given India's vast and diverse genetic landscape, a dedicated project like GIP was necessary.

Tamil Nadu Bans Mayonnaise

Sub Topics: *Biotechnology, Health, Animal Food Products*

Context:

The Tamil Nadu government has **banned the manufacture, storage, distribution, and sale** of **mayonnaise made using raw eggs**.

More on News

- The **ban came into effect on April 8, 2025**, and will remain in force for **one year**.
- The move was made to address **public health risks**, especially foodborne illnesses caused by bacterial contamination.

What is Mayonnaise?

- Mayonnaise is a **semi-solid emulsion** made from **egg yolk, vegetable oil, vinegar**, and **seasonings**.
- Traditional recipes include three core ingredients: **oil, egg yolk**, and an **acid** (like lemon juice or vinegar).
- The **protein in the egg** acts as an emulsifier, helping bind oil and water into a stable mixture.
- It originated in **France or Spain** (exact origin debated), and is now widely used across **global fast food cuisines**.
- Commonly used in **sandwiches, burgers, shawarmas, and momos**.

Why Are Raw Eggs Dangerous in Mayonnaise?

- **Raw eggs** can carry **pathogens** that are normally destroyed during cooking.
- **Health risk**: Mayonnaise with raw eggs is considered a **high-risk food** due to the **potential for food poisoning**.
- In **Indian climatic conditions** (hot and humid), risks increase due to **improper storage and preparation**.
- **Major bacterial threats**:
  - **Salmonella**: According to the **U.S. Centres for Disease Control and Prevention (CDC),** Salmonella is a leading cause of **foodborne illnesses**, hospitalisations, and deaths globally.
    - Salmonella **thrives in warm, humid conditions**, which makes **places like India**, especially during hot months, **a prime environment for bacterial growth**.

- **E. Coli**: While most strains of E. coli are harmless and even beneficial for digestion, certain types can cause severe illness. These bacteria pose a particular risk to vulnerable populations such as children, the elderly, and immunocompromised individuals.

Impact of the Ban

- Mayonnaise has become **increasingly popular** in Indian urban fast food culture over the last **two decades**.
- The ban may compel food businesses to **switch to eggless or pasteurised-egg** versions.
- **Majority of mayonnaise in India is already eggless**, reducing overall disruption.
- Tamil Nadu follows **Telangana**, which banned raw egg mayo in **November 2024**.
- The move is in line with other health-related bans in the state, such as those on **gutka and paan masala**.

Related Developments

- In **Punjab**, the **Food and Drug Administration** imposed a **one-year ban** on **caffeinated energy drinks** for children and around schools.
- The ban is based on **serious health concerns** related to **caffeine and other stimulants**.
- A **scientific study** is underway in Punjab to assess the **impact of caffeine** on minors.

Life Detected on Distant Exoplanet K2-18b

Sub Topic: *Space Technology, Planatory Exploration Mission*

Context:

A team of astronomers has detected what may be the **most promising signs of extraterrestrial life** on the exoplanet **K2-18b**, located **124 light-years away**. However, the researchers remain cautious and have not declared a definitive discovery of life beyond Earth.

More on News

- The discovery was led by **Dr. Nikku Madhusudhan**, an Indian-origin astrophysicist and professor at the **University of Cambridge**.
- Data was collected using **NASA's James Webb Space Telescope (JWST)**, revealing potential **biosignatures** in the planet's atmosphere.

What is K2-18b?

- K2-18b is an **exoplanet**—a planet that orbits a star outside our solar system.
- It orbits the **cool red dwarf star K2-18**, situated in the **Leo constellation**.
- Lies within the **habitable zone** of its star, where **liquid water** could potentially exist.
- Approximately **2.6 times the size of Earth** and **8.6 times its mass**.
- Classified as a **sub-Neptune**—a type of planet not found in our solar system but believed to have **hydrogen-rich atmospheres** and possibly **liquid water oceans**.

Key Findings

- Using JWST's **Near-Infrared Imager and Slitless Spectrograph (NIRISS)** and **Near-Infrared Spectrograph (NIRSpec)** instruments, the team detected:
  - **Methane (CH_4)** and **Carbon Dioxide (CO_2)**.
  - **Absence of Ammonia (NH_3)** — supporting the Hycean planet hypothesis.
- Most notably, a **possible signal of Dimethyl Sulfide (DMS)** — a molecule on Earth produced **only by living organisms**, especially marine phytoplankton. NASA emphasised the **DMS detection is not yet confirmed** and requires further observation.
- The presence of these sulphur-based molecules is **consistent with predictions** for a **Hycean world**, a new class of planet theorised to have **warm oceans** under a **hydrogen-rich atmosphere**.

NASA's Parker Solar Probe

Sub Topic: *Space Technology, Space Missions*

Context:

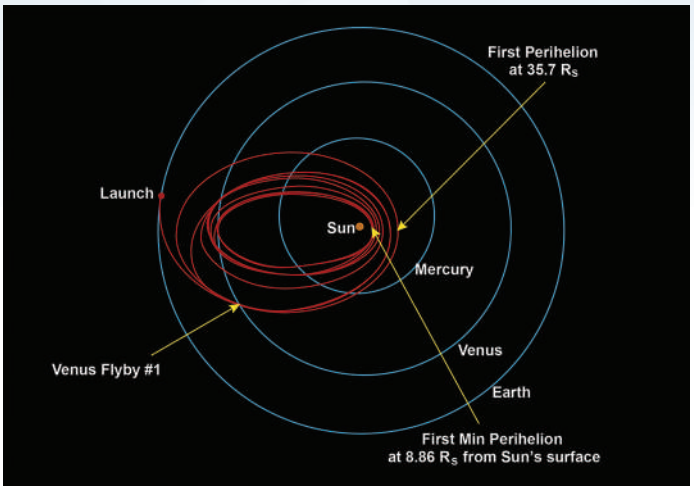
On December 24, 2024, NASA's Parker Solar Probe achieved an extraordinary milestone by **approaching within 6.1 million kilometres of the Sun's surface**—closer than any spacecraft before it.

More on News

- This achievement was the **result of a seven-year journey**, with the probe continuing its mission by making additional close approaches on March 22 and June 19 of this year.

Advanced Heat Shield Technology

- The Parker Solar Probe is named in honour of **Eugene Parker,** who **predicted the existence of the solar wind**—an outward flow of charged particles from the Sun in all directions.
  - Launched in August 2018 aboard a Delta IV rocket from Cape Canaveral, the probe **reached an astounding speed of 692,000 km/h.**



- To withstand the Sun's intense heat, the **probe is equipped with an advanced heat shield**—an 8-foot-wide, 4.5-inch-thick carbon-carbon composite capable of enduring temperatures of up to 1,370º C while weighing only 73 kg.
  - Designed by researchers at the **Johns Hopkins Applied Physics Laboratory**, the shield features **a carbon composite foam core sandwiched between two carbon plates,** with its Sun-facing surface coated in white ceramic paint to reflect solar radiation.
- Remarkably, just a few meters behind the shield, the **temperature drops to a manageable 29º C, allowing the probe's scientific instruments to function without the need for special cooling measures.**
- The probe also includes **two sets of solar power arrays**—one positioned in the shield's shadow to power scientific instruments and another exposed to sunlight, equipped with a fluid cooling system to sustain the probe during its closest approaches.

Navigating the Solar System

- Surprisingly, the **biggest challenge** for the Parker Solar Probe **wasn't the Sun's heat but its immense gravitational pull.**
- To prevent the probe from plunging directly into the Sun, scientists devised **an intricate flight path.**
  - Initially, a route involving Jupiter's gravity to decelerate the probe was considered but ultimately discarded due to the excessive travel distance.
- Instead, the **final trajectory used gravity assists from Earth and Venus,** enabling the probe to spiral closer to the Sun over time.
  - This approach has allowed it to spend more than 2,000 hours flying through the corona and conducting 24 passes along the solar equator.

Scientific Exploration and Discoveries

- The Parker Solar Probe is outfitted with four key scientific instruments:
  - **FIELDS:** Measures the Sun's electric and magnetic fields.
  - **ISoIS (Integrated Science Investigation of the Sun):** Observes energetic particles responsible for solar storms.
  - **SWEAP (Solar Wind Electrons Alphas and Protons):** Analyses properties of the solar wind.
  - **WISPR (Wide-Field Imager for Parker Solar Probe):** Captures images of the corona during flybys.
- In April 2021, Parker made history by **becoming the first spacecraft to cross the Sun's Alfvén surface**—the **boundary beyond which solar wind no longer influences the Sun's surface.**
  - This was confirmed by data from the FIELDS and SWEAP instruments.
- Additionally, a **specialised instrument called the Faraday cup,** which lies outside the heat shield, **measures the density of charged particles in the solar wind.**
- Constructed from a molybdenum alloy with a melting point of 2,349º C, it withstands the Sun's extreme conditions to provide crucial data.

Breakthrough Discoveries in Solar Physics

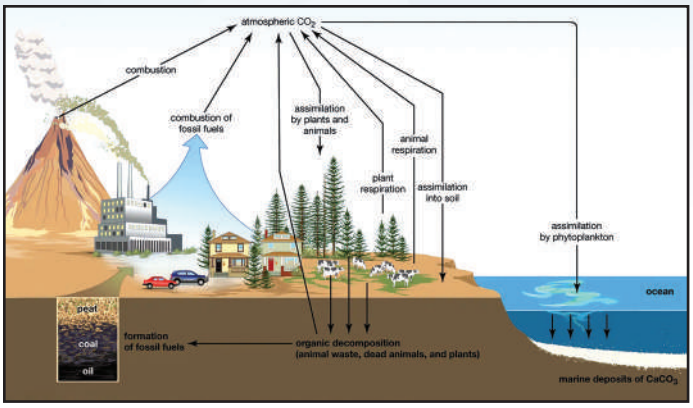
- Previously, scientists assumed that **space dust**, formed by weathering cosmic rocks, was uniformly distributed throughout the solar system.
  - However, **Parker detected regions near the Sun that are free of dust.**
  - The probe also observed **magnetic switchbacks**—sections of the solar wind where the magnetic field unexpectedly bends backward.
- One of the most significant questions in solar physics is **why the Sun's surface is relatively cool at approximately 6,000ºC, while the corona is exponentially hotter at around 1 million degrees.**
  - Parker's findings suggest that **Alfvén waves—plasma oscillations driven by magnetic forces—may hold the key to solving this mystery.**

ESA's Biomass Mission

Sub Topic: *Biotechnology, Bio Fuels*

Context:

The **European Space Agency (ESA)** is preparing to launch its **groundbreaking Biomass mission later this month,** aimed at producing the first-ever comprehensive global map of forest biomass.



More on News

- By tracking changes in the world's forests, the **mission will enhance our understanding of how these vital ecosystems influence the planet's carbon cycle and climate.**
- Set for launch on April 29, the **satellite will be carried into space by a Vega C rocket from ESA's Korou spaceport in French Guiana.**
- Once in orbit — specifically a **sun-synchronous orbit** at an altitude of around 666 kilometers — the satellite will maintain a consistent position relative to the Sun, ensuring uniform data collection over time.

Why Is the Biomass Mission Important?

- **Carbon** is the **fundamental building block of life, from microorganisms to towering redwoods.**
- While the **Earth does not gain or lose carbon, this element constantly cycles through the atmosphere, oceans, soil, and living organisms** — a natural process known as the **carbon cycle.**
- **Forests are crucial in this cycle,** acting as vast **carbon reservoirs.**
  - They are believed to **absorb around 16 billion metric tonnes of CO_2 annually** and currently hold about 861 gigatonnes of carbon within their soils and vegetation.
- Despite their importance, **there is a glaring lack of global data on forest biomass** — the total mass of living organic matter within forests. This gap hinders scientists' ability to accurately assess forest health and their role in regulating the planet's climate.
- **ESA's Biomass mission** will **enable researchers to monitor how carbon storage in forests changes over time,** especially in the context of increasing deforestation and rising atmospheric CO_2 levels.
  - According to the **World Resources Institute, Earth lost 3.7 million hectares of tropical forests in 2023 alone** — roughly equivalent to losing 10 football fields of forest every minute.
  - This deforestation was responsible for approximately 6% of global CO_2 emissions that year.

How Will the Biomass Mission Work?

- To achieve its objectives, the Biomass satellite is equipped with a massive 12-meter antenna that will utilise a **synthetic aperture radar (SAR).**
- Uniquely, it will be the first satellite to operate a **long-wave P-band SAR in space.**
- Unlike shorter wavelengths, **P-band radar can penetrate thick forest canopies, allowing scientists to measure the biomass not just in the treetops, but also in branches, trunks, and even forest floors.**
- This powerful radar technology will provide **3D maps of forest structures,** helping researchers "weigh" forests and calculate their carbon content with unprecedented accuracy.
- By capturing this data, the mission will offer critical insights into the balance of carbon flow between Earth and its atmosphere, informing both scientific understanding and climate policy.

First Miniaturised Lasers Directly on Silicon Chips

Sub Topic: *Information Technology, Emerging Technologies, Optics*

Context:

The invention of **silicon chips** revolutionised communication systems, becoming the **foundation of modern technologies** for global information transfer. Recent advances, however, are **shifting from electrons to photons (light particles)**, especially in the field of silicon photonics. This innovation is making waves in data centers, sensors, and even in quantum computing.

Key Developments in Silicon Photonics

- **Transition from Electrons to Photons**: Traditional chips rely on electrons to transfer information, but silicon photonics uses photons for higher data capacity, faster information transfer, and lower energy consumption.
- **Breakthrough Study in Nature**: Researchers from the US and Europe have successfully fabricated the first miniaturised lasers directly on silicon wafers. This advancement marks a significant leap forward in silicon photonics.
- **CMOS Compatibility**: The new technique uses a standard CMOS manufacturing line, which is already in use for creating electronic chips, ensuring compatibility with existing industry practices.

Advantages of Photons Over Electrons

- **Speed**: Photons enable faster data transmission.
- **Energy Efficiency**: Photons incur lower energy losses than electrons.
- **Higher Data Capacity**: Photons carry more data, making them ideal for handling large volumes of information.

Challenges with Photons

- **Integration Issue**: The main challenge is integrating a light source (laser) onto the silicon chip.
- **Current Workaround**: Engineers attach separate lasers to chips, but this results in slower performance and higher costs due to manufacturing mismatches.
- **New Approach**: Researchers have developed a method to grow lasers directly on silicon chips, which could be more scalable and cost-effective.

Key Components of a Photonic Chip

- **Laser (Light Source)**: The laser is the core component that generates light for the chip.
- **Waveguides**: Serve as channels for photons, similar to how wires direct electrons.
- **Modulators**: Encode and decode information onto light signals by altering properties such as intensity, wavelength, or phase.
- **Photodetectors**: Convert light signals back into electrical signals for further processing.

How Lasers Work?

- **Stimulated Emission**: Lasers work through a process called stimulated emission, where incoming photons excite electrons in a higher energy state to fall to a lower state, emitting more photons. This process creates a coherent beam of light, known as a laser.
- **Silicon and Light Emission**: Silicon is not naturally efficient at emitting light due to its indirect bandgap, requiring additional particles for efficient energy release. Most lasers use materials like gallium arsenide, which has a direct bandgap, making it more energy-efficient for light emission.

Challenges in Integrating Gallium Arsenide with Silicon

- **Crystal Mismatch**: Silicon and gallium arsenide have different atomic structures, causing defects when combined. These imperfections result in energy loss as heat rather than light, reducing laser efficiency.

Research Innovations

- **Nanometre-sized Ridges**: Researchers used nanometre-wide ridges to minimise defects when integrating gallium arsenide onto silicon. This method traps defects at the bottom of trenches, allowing a pure gallium arsenide layer to grow above.
- **Indium Gallium Arsenide Layers**: Three layers of indium gallium arsenide were deposited on the chip to act as the laser's light source.
- **Indium Gallium Phosphide**: A protective layer of indium gallium phosphide was applied on top of the entire setup to ensure stability.
- **Electrical Contacts**: Electrical contacts were added to provide the necessary current for the laser to function.

Results of the Study

- **Integration of 300 Lasers**: The team successfully embedded 300 functional lasers onto a single 300-mm silicon wafer, which is the industry standard for semiconductor manufacturing. This makes the new approach scalable and easy to integrate into existing manufacturing lines.
- **Laser Performance**: The laser emitted light with a wavelength of 1,020 nm, ideal for short-range chip-to-chip communication. The threshold current required for operation was 5 mA, similar to the current needed for an LED in a computer mouse.
  - The laser's output was around 1 mW. The laser could operate continuously for 500 hours at room temperature (25°C), with its efficiency slightly dropping at 55°C.
- **Future Improvements**: Ongoing research has shown that optical silicon chips can operate at temperatures up to 120°C, highlighting areas for further optimisation in laser stability.

IISc Proposes Angstrom-Scale Chips

Sub Topic: *Information Technology, Emerging Technologies*

Context:

A **30-member scientist team** from the **Indian Institute of Science (IISc)** has submitted a **revised proposal (detailed project report (DPR))** to the Government of India to develop **angstrom-scale semiconductor chips**—a next-gen technology significantly smaller than current 3-nanometer chips.

More on News

The project is centred around **2D materials** such as **graphene** and **transition metal dichalcogenides (TMDs)**, which offer the potential to surpass the limitations of current **silicon-based chips**.

What are Angstrom-Scale Chips?

- **1 angstrom (Å) = 0.1 nanometer**.
- These chips could be **up to 10x smaller** than the smallest commercial chips (currently 3nm, by Samsung and MediaTek).
- The use of **2D materials** enables **atomic-level precision**, potentially revolutionising **speed, efficiency, and power consumption** in electronic devices.

Timeline and Government Engagement

- Initial DPR submitted to the **Principal Scientific Adviser (PSA)** in **April 2022**, revised and resubmitted in **October 2024**.
- Shared with **MeitY**, **DRDO**, **Department of Space**, and supported by **NITI Aayog** (Sept 2022).
- Ongoing discussions and meetings are held between the **PSA office** and **MeitY**; the latter is exploring practical electronic applications for the technology.

Funding & Investment

- **The IISc-led team has requested Rs 500 crore** over 5 years — modest when compared to the **Rs 91,000 crore Tata-PSMC project** under the India Semiconductor Mission.
- Includes a **self-sustaining roadmap** post-initial funding.
- In comparison, **Europe has invested over USD 1 billion**, and **South Korea over USD 300 million** in 2D semiconductor research.

Global Context

- Countries worldwide are preparing for a **post-silicon era**, with significant R&D on 2D semiconductors already underway.
- India's **deliberations must shift to execution**, or it risks missing a historic opportunity for leadership in next-gen semiconductor tech.

New Quantum-Based Navigation System 50 times More Accurate Than Traditional GPS

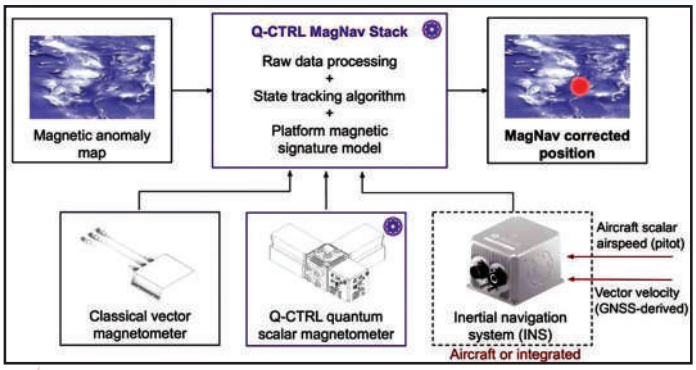
Sub Topic: *Information Technology, Quantum Physics, Navigation System*

Context:

Q-CTRL, a Sydney-based quantum infrastructure software firm, has announced the successful development and demonstration of a **quantum navigation system** named **Ironstone Opal**. The research paper detailing the workings and performance of Ironstone Opal has been published on the **arXiv preprint server**.

Background and Need

- **GPS Vulnerability**: The global reliance on GPS for navigation—spanning private, commercial, and military sectors—has exposed critical vulnerabilities.



- **Potential Consequences**: GPS outages can lead to widespread navigation failures for drivers, aircraft pilots, and military operations.
- **Search for Alternatives**: The vulnerability has sparked global research into robust backup systems or full alternatives to traditional GPS.

Ironstone Opal – How It Works

- **Quantum Sensors**: Utilises **highly sensitive quantum sensors** to measure Earth's magnetic field with extreme precision.
- **Magnetic Mapping**: Earth's magnetic field varies by location; the sensors use this variation to determine precise **geographic X and Y coordinates**.
- **AI Integration**: Employs **AI-driven software** to analyse sensor data and calculate position, mimicking the output of GPS systems.

System Advantages

- **High Accuracy**:
  - **Ground Tests**: Demonstrated to be **50 times more accurate** than any existing GPS backup system.
  - **Aerial Tests**: Found to be **11 times more accurate** in airborne scenarios.
- **Passive Technology**: Does not emit signals—making it **undetectable and immune to jamming or interference**.
- **Noise Filtering**: Software filters out magnetic "noise" caused by the host vehicle (cars, planes, etc.).
- **Compact Design**: Small enough to be easily installed in **cars, trucks, drones, and aircraft**.

Potential Impact

- Ironstone Opal offers a **next-generation navigation solution**, especially valuable in **GPS-denied environments** or **conflict zones** where jamming is a risk.

- Promises major advancements in **military, aviation, and autonomous vehicle navigation**.

India Became 4th Country to Develop Directed Energy Weapon

Sub Topic: *Defence Technology, Missiles*

Context:

On **April 13, 2025**, the **Defence Research and Development Organisation (DRDO)** announced the **successful trial** of its **Mk-II(A) Laser-Directed Energy Weapon (DEW)** system.

More on News

- The successful test marks **India's entry into an exclusive group of nations** that possess **high-power Laser-DEW technology**.
- Demonstrates India's **mastery in disabling missiles, drones, and smaller projectiles** with precision and speed.

Trial and Development

- The successful trial was conducted at the **National Open Air Range in Kurnool**, Andhra Pradesh.
- Developed by **DRDO's Centre for High Energy Systems and Sciences (CHESS), Hyderabad**.
- **Involvement of:** In collaboration with **LRDE** (Electronics & Radar Development Establishment), **IRDE** (Instruments Research & Development Establishment), **DLRL** (Defence Electronics Research Laboratory), Indian industries, and academic institutions**.**

Cost-Effectiveness

- The **cost of firing** the DEW for a few seconds is **equivalent to a few litres of petrol**.
- Considered a **low-cost, long-term alternative** to conventional missile defence and kinetic systems.
- Makes the system an attractive choice for **frequent, rapid-response combat situations**, especially against **low-cost drone attacks**.

Demonstrated Capabilities

- **Indigenously designed and developed**, the Mk-II(A) DEW system was tested in its **entire operational spectrum**.
- Key capabilities demonstrated:
  - **Engagement of fixed-wing drones** at long range.
  - **Thwarting multiple drone attacks** simultaneously.
  - **Destruction of enemy surveillance sensors and antennae**.
- Described as a **"potent counter-drone system"** due to:
  - **Lightning speed of engagement**.
  - **High precision**.
  - **Lethality at the target within seconds**.

Technology and Functioning

- Once a threat is detected by **radar or an in-built Electro-Optic (EO) system**, the laser engages at the **speed of light**.
- Employs an **intense laser beam** to:
  - **Cut through the target**.
  - Induce **structural failure**.
  - Deliver greater damage if the **warhead is targeted**.
- Potential to **revolutionise modern warfare** by:
  - Reducing **reliance on expensive ammunition**.
  - Minimising **collateral damage**.

Strategic Relevance

- Rising threats from **Unmanned Aerial Systems (UAS)** and **drone swarms** have made DEWs a **strategic necessity**.
- **Asymmetric warfare threats** like drone swarms are driving demand for **counter-UAS and counter-swarm DEWs**.
- This trial marks India's entry into an **exclusive group of global powers** with high-power laser-DEW capabilities. DRDO Chairman **Samir V. Kamat** said that **India is the fourth or fifth country** to demonstrate such a system.
  - Other countries with demonstrated capabilities include: the **USA, Russia, China**, and **Israel (in development)**.
- DRDO predicts that DEWs will **soon replace traditional kinetic weapons and missile defence systems**, citing: **Ease of operation, Rapid response,** and **Affordability.**

Mains

Electronic Warfare Modernisation with SAMBHAV, Samyukta, Himashakti, and AI

Sub Topic: *Challenges to internal security through communication networks, role of media and social networking sites in internal security challenges, basics of cyber security; money-laundering and its prevention.*

Context:

In today's digitised battlefields, dominance is no longer achieved solely through superior firepower—it hinges on **control of the electromagnetic (EM) spectrum.**

More on News

- From communications and navigation to surveillance and targeting, every element of modern warfare depends on this **invisible infrastructure.**
- Without it, armed forces are rendered blind, deaf, and disconnected.

Why Electromagnetic Spectrum Superiority is Critical for India?

- **Nuclear Neighbours:** India, with its **extensive and disputed borders** shared with **two nuclear-armed neighbours**—China and Pakistan—faces an urgent need to achieve superiority in electronic warfare (EW).
- **Evolving Nature of Warfare:** As the nature of warfare rapidly evolves with the **rise of drones, satellites, cyber capabilities,** and network-centric operations, India's armed forces are adapting at pace.
- **Military Doctrine:** Electronic Warfare is no longer just a support function—it has become **central to India's military doctrine, particularly for the Indian Army,** which is spearheading **efforts to modernise and fortify national defence through advanced EW systems.**

Army Chief's Vision: EW at the Core of Modernisation

- While addressing the 64th National Defence College (NDC) Course, **Army Chief General Upendra Dwivedi outlined the Indian Army's future-forward roadmap** based on five strategic pillars:
  - Jointness and Integration
  - Force Restructuring
  - Modernisation and Technology Infusion
  - Systems, Processes, and Functions
  - Human Resource Management
- The third pillar, **Modernisation and Technology Infusion,** includes a decisive **push to secure the Army's communication and EW infrastructure under contested and high-threat conditions.**

SAMBHAV: A Secure Mobile Communication Backbone

- At the forefront of this initiative is SAMBHAV (Secure Army Mobile Bharat Version)—an **indigenously developed, encrypted communication platform built for operational and tactical use.**
- Unlike commercial apps, SAMBHAV **provides military-grade security for field personnel,** ensuring uninterrupted and secure connectivity during EW scenarios, where communications are often the first targets.
- It plays a vital role in **strengthening the Army's resilience against jamming, interception, and cyber threats.**

Samyukta: India's Integrated EW Powerhouse

- India's flagship EW system, Samyukta, marks a **significant step towards tactical dominance.**
- Co-developed by **DRDO, BEL, ECIL, and the Corps of Signals,** Samyukta is a **mobile, integrated platform capable of intercepting, monitoring, and jamming a broad spectrum of enemy signals—from HF to millimetre waves.**
- Its ability to perform both **Electronic Support Measures (ESM) and Electronic Countermeasures (ECM)** makes it indispensable for battlefield superiority.
- Mobility ensures rapid deployment across conflict zones, giving the Army a decisive electronic edge.

Himashakti: EW Dominance in High-Altitude Warfare

- Operating in mountainous terrain along the **Line of Actual Control (LAC)** with China demands specialised capabilities.

- Himashakti, **India's high-altitude EW system,** meets that challenge.

- Built to **perform in oxygen-deprived, sub-zero environments,** it delivers precision signal detection and jamming in line-of-sight-restricted regions.
- Integrated with drones, satellites, and networked command systems, Himashakti offers **real-time situational awareness,** enabling proactive responses even in the most difficult geographies.

IEWP: Total Spectrum Supremacy

- The **Integrated Electronic Warfare Platform (IEWP)** further enhances India's spectrum warfare capabilities.
- Designed for **multi-terrain deployment,** IEWP features low, mid, and high-frequency jamming modules—all interconnected to a centralised Command Centre via encrypted, redundant networks.
- This modular, layered system supports **Electronic Counter-Countermeasures (ECCM)** to resist enemy disruption attempts, making IEWP a strategic asset that disrupts enemy command chains even before kinetic operations begin.

AI-Powered EW: Speed, Precision, and Autonomy

- Artificial Intelligence (AI) is now revolutionising India's electronic warfare strategy.
- By enabling real-time signal classification, threat analysis, and pattern recognition, AI systems dramatically reduce response times and improve decision-making under pressure.
- AI-integrated platforms like Samyukta, Himashakti, and IEWP can autonomously **execute jamming or spoofing tactics,** adapt to changing enemy tactics, and dynamically collaborate across multiple systems.
- This adds a **layer of agility and foresight,** empowering EW units to act before threats materialise.

Cyber-EW Convergence: Multi-Domain Operations in Action

- India is also embracing **Multi-Domain Operations (MDO)**—a warfare concept that unifies land, air, sea, space, and cyber domains.
- The convergence of cyber capabilities with EW ensures that enemy networks are not only jammed but also digitally compromised.
- During joint exercises, Army EW units simulate jamming enemy lines while cyber teams target backend infrastructure.
- This coordination reflects a doctrine shift—one that integrates cyber-electronic strategies for comprehensive battlefield impact.

India's Suspension of the Indus Waters Treaty: A Strategic Shift in Water Diplomacy

Sub Topic: *India and its neighbourhood- relations.*

Context:

On **April 23, 2025**, India **suspended the Indus Waters Treaty (IWT)** in response to the **terror attack in Pahalgam**, Jammu & Kashmir, which resulted in the death of **26 Indian and foreign tourists**.

More in News

- The decision was taken by the **Cabinet Committee on Security**, marking **India's most assertive move** against Pakistan since the signing of the treaty in 1960.
- This strategic escalation signals a **paradigm shift in India's counter-terrorism policy**, utilising hydrological leverage as an instrument of statecraft.

Suspension of Indus Waters Cooperation

India has suspended the Indus Waters Treaty, under which 39 billion cubic meters of water from the Indus River system flows from India into Pakistan annually.

India's Five Strategic Counter-Measures Post-Pahalgam Attack

- **Suspension of Indus Waters Treaty**:
  - Treaty placed **"in abeyance"** until Pakistan **irrevocably ends support for terrorism**.
  - A historic first – previously **threatened but never executed**.
- **Closure of Integrated Check Post (ICP) Attari**:
  - **Immediate halt** to movement of goods and people across the border.
  - Severely impacts **bilateral trade** and people-to-people contact.
- **Termination of SAARC Visa Exemption Scheme (SVES)**:
  - All **Pakistani SVES visa holders were ordered** to **leave India within 48 hours**.

- Future exemptions revoked, curbing **diplomatic and business visits**.

❖ **Expulsion of Pakistani Military Advisors**:

- **Defence, Naval, and Air advisors** at Pakistan High Commission declared **persona non grata**.
- India to **withdraw its military staff** from Islamabad.

❖ **Reduction in Diplomatic Staff Strength**:

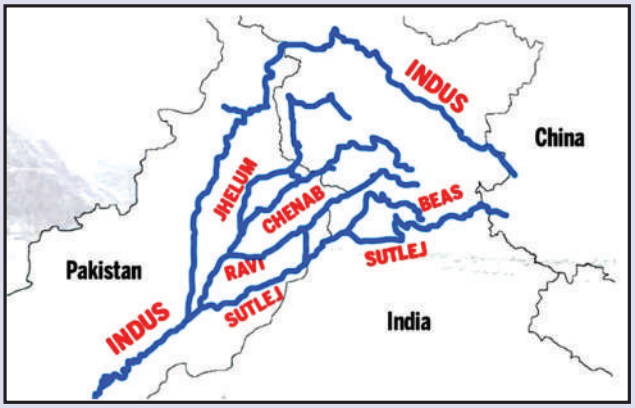
- Missions were downsized from **55 to 30 personnel** in both countries by **1st May 2025**.
- Retains **minimal engagement** while curbing formal diplomatic relations.

Background: The Indus Waters Treaty (IWT)

❖ **Signed in 1960**, the treaty was **brokered by the World Bank** after nine years of negotiations.

❖ **Rivers covered** under the Indus Basin system:

- **Eastern Rivers – Ravi, Beas, Sutlej → allocated to India**.
- **Western Rivers – Indus, Jhelum, Chenab → allocated to Pakistan**, with India allowed **non-consumptive usage** (e.g., hydropower).



❖ **Water Allocation**:

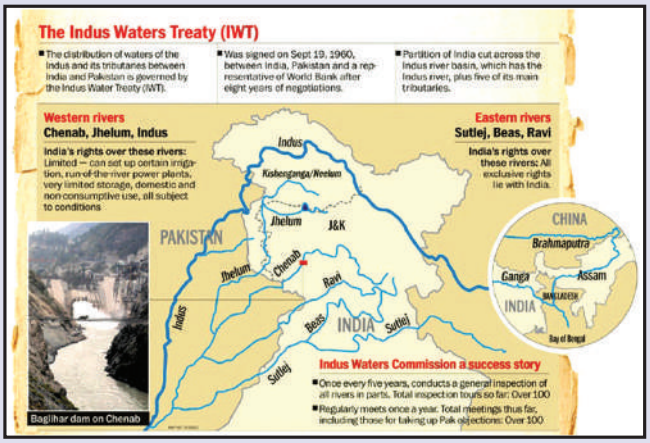
- **India**: ~20% (~33 MAF or 41 BCM annually).
- **Pakistan**: ~80% (~135 MAF or 99 BCM annually).

❖ **Restrictions on India**:

- No obstruction or alteration of water flow on western rivers.
- Usage restricted to **non-consumptive purposes** only.

❖ **Dispute Resolution Mechanism under IWT**

- **Three-Tiered System**:
  - **Permanent Indus Commission (PIC)** – Regular technical-level engagement.
  - **Neutral Expert** – Appointed by the World Bank for technical disputes.



- **Permanent Court of Arbitration (PCA)** – Under Article IX for unresolved issues.

➢ **Neutral Expert decisions** are **final and binding**, as seen in Kishenganga and Baglihar disputes.

Strategic Importance of the Indus System for Pakistan

❖ **Agricultural Dependency**:

- 80% of **Pakistan's cultivated land (~16 million hectares)** is Indus-dependent.
- 93% of the water is used for **irrigation**.

❖ **Population & Urban Dependence**:

- Supports over **237 million people**; Pakistan hosts **61% of the basin's population**.
- Major cities like **Karachi, Lahore, and Multan** depend on it for **drinking water and industry**.

❖ **Energy Security**: Key **hydropower plants** (e.g., Tarbela, Mangla) require consistent water flows.

❖ **Economic Contribution**:

- Indus-dependent sectors contribute nearly **25% of Pakistan's GDP**.
- Sustains major crops like **wheat, rice, sugarcane, and cotton**.

❖ **Vulnerability**:

- Pakistan is among the **most water-stressed nations globally**.
- Any disruption could lead to **food insecurity, urban water crises, power outages, and social unrest**.

Legal and Diplomatic Dimensions of the Treaty Suspension

❖ **Treaty Cannot Be Unilaterally Abrogated**: As per **Article XII of IWT**, termination requires **bilateral agreement**.

- **India's Legal Rationale**:
  - Though **not a signatory to the Vienna Convention**, India invokes **Article 62** – fundamental change in circumstances.
  - Refers to IWT's own **Article 3**, allowing **storage and hydropower development** within limits.
- **Precedents & Notification**:
  - India had earlier **notified Pakistan in January 2023** to renegotiate the treaty.
  - Grounds cited included **strategic and environmental concerns**.

Operational and Strategic Leeway Gained by India

- **Unrestricted Reservoir Operations**:
  - No obligation to follow monsoon timelines for **flushing or filling reservoirs** like Kishenganga and Ratle.
  - Enhanced **silt management and dam efficiency**.
- **Infrastructure Development**:
  - India may now **construct new hydropower projects** without facing **Pakistani objections or arbitration**.
  - Past contentious projects: **Salal, Baglihar, Kishenganga, Ratle**.
- **No Obligation to Share Flood Data**: Could **impede early warnings** during monsoon floods in downstream areas.
- **Increased Storage and Diversion Rights**:
  - India may store water **up to or beyond 3.6 MAF** on western rivers.
  - Possible **usage for irrigation, drinking, and energy** purposes.
- **Suspension of Joint Mechanisms**:
  - No meetings of the **Permanent Indus Commission (PIC)**.
  - Pakistan is barred from **inspecting Indian project sites**.

Global and Regional Strategic Implications

- **Precedent for Other Riparian States**: May embolden **upstream countries** to assert water control in **other transboundary basins**.
- **International Reactions**: **Global condemnation of terror attack**; many nations expressed **solidarity with India**.
- **Pakistan's Expected Response**:
  - May invoke **World Bank mediation** or call for **UN/ICJ intervention**.
  - Likely diplomatic campaign to garner **international support**.
  - **India's Diplomatic Standpoint**: Emphasises **bilateral nature of the treaty** and lack of binding force from international law unless **renegotiated**.

Conclusion:

Strategic Assertiveness and Geopolitical Calculus

- India's suspension of IWT reflects a **zero-tolerance policy on terrorism** with **multi-dimensional retaliation**:
  - **Diplomatic downgrading**
  - **Trade isolation**
  - **Hydrological leverage**
- Represents a **departure from post-Uri and Pulwama restraint**, signaling a **new era in regional statecraft**.
- However, long-term consequences must be **carefully weighed**:
  - Risk of **environmental fallout**
  - Escalation in **water conflicts**
  - Impact on **regional stability**
- The world now watches whether **Pakistan chooses confrontation or conciliation**.
- India, meanwhile, has demonstrated **strategic maturity** and an evolving doctrine of **coercive diplomacy under international norms**.

75 Years of China-India Diplomatic Relations

Sub Topic: *India and its neighbourhood- relations.*

Context:

April 1 marked the 75th anniversary of diplomatic relations between China and India.

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- Over the decades, despite facing challenges, the **bilateral relationship has continued to progress, much like the steady flow of the Yangtze and the Ganges.**

Principles of Future Relations

As we reflect on this journey, **four key factors emerge as guiding principles for the future of China-India relations:**

- **Leadership and Strategic Direction:** The role of leadership has been **instrumental in shaping China-India relations.**
  - **India was the first non-socialist country to establish diplomatic relations with China.**
  - In 1988, **Prime Minister Rajiv Gandhi's visit to China** marked a turning point, **initiating a process of normalisation.**

- More recently, **interactions between President Xi Jinping and Prime Minister Narendra Modi,** including informal summits and bilateral meetings, have strengthened ties.

- **Strengthening Cooperation and Cultural Exchanges:** Historically, China and India have **shared deep-rooted cultural connections.**
  - From the **travels of Master Xuanzang to Bodhidharma's** influence on Zen Buddhism, these exchanges have enriched both civilisations.
  - In the modern era, **bilateral trade has grown significantly**—from less than **$3 billion in 2000 to $138.5 billion in 2024.**
  - **Educational, tourism and cultural collaborations have expanded,** with **yoga and Bollywood** gaining popularity in China.
  - The two nations have also established **nearly 50 dialogue mechanisms** to facilitate discussions across various sectors, reinforcing their commitment to collaboration.
- **Managing Differences Through Dialogue:** As neighboring countries, differences are inevitable.
  - However, both nations recognise the **importance of preventing disputes from escalating.**
  - The establishment of **communication channels** such as the **Special Representative Mechanism on the China-India Boundary Question** has enabled constructive dialogue.
  - Last year's efforts to restore stability along the border exemplify the **effectiveness of diplomatic negotiations** in resolving complex issues. Emphasising dialogue over discord remains key to maintaining regional stability.
- **A Shared Responsibility in Global Affairs:** China and India, as leading members of the **Global South,** hold significant influence on the global stage.
  - Historically, they have worked together to promote the **Five Principles of Peaceful Coexistence (PANCHSHEEL)** and supported the independence movements of Asian and African nations.
  - Today, their **cooperation in multilateral organisations** like **BRICS**, the Shanghai Cooperation Organisation **(SCO), and the G-20** is vital for advancing global economic and political stability.
  - By aligning their efforts, both nations can **contribute to international fairness, justice, and multilateralism.**

Areas of Cooperation and Confrontation

India and China have a complex relationship characterised by both cooperation and confrontation across various sectors.

Areas of Cooperation:

- **Economic Cooperation:**
  - **Bilateral Trade:** India and China have significant trade relations, with bilateral trade reaching $138.5 billion in 2024.
  - **Investments:** Both countries have seen increased investments in sectors like IT, pharmaceuticals, and automobiles.
  - **Multilateral Forums:** They collaborate through platforms like BRICS, SCO, and AIIB to promote economic development.
- **Science and Technology:** Joint research workshops and IT corridors in China have fostered collaboration in science and technology.
- **Cultural and Educational Exchanges:** Increased people-to-people exchanges, including over 18,000 Indian students in China. Cultural exchanges through **sister cities** and educational programs.
- **Environmental Cooperation:** Both countries are parties to the **Paris Agreement and collaborate on climate change initiatives.**
- **Security Cooperation:** Limited defence cooperation, including joint military exercises like **"Hand-in-Hand".**

Areas of Confrontation:

- **Border Disputes:** The **Line of Actual Control (LAC)** is a major source of tension, with frequent skirmishes and military standoffs, notably in **Ladakh and Arunachal Pradesh.** The **2020 Galwan Valley clash** resulted in significant casualties on both sides.
- **Geopolitical Competition:** India's revocation of special autonomy in Jammu and Kashmir in 2019 was opposed by China, further straining relations. Competition for influence in **South Asia and the Indian Ocean region.**
- **Economic Tensions:** India has restricted Chinese investments and banned several Chinese apps following border tensions. **Trade imbalances and competition** in regional markets.
- **Strategic Rivalries: India's participation in the Quad** (with the U.S., Japan, and Australia) is seen as a **counterbalance to China's growing influence in the Indo-Pacific.** China's **Belt and Road Initiative (BRI)** has raised concerns in India about regional security and economic dominance.

Way Ahead

To sustain and enhance this relationship, both nations must take proactive steps:

- **Fostering Stability:** Upholding **mutual respect and trust** while managing differences through dialogue will ensure a steady and balanced relationship.
- **Expanding Economic Cooperation:** Aligning developmental goals, such as China's high-quality growth strategy and India's **"Viksit Bharat 2047"** vision, can create new opportunities for trade and investment.
- **Strengthening Multilateral Engagement:** As key players in global governance, China and India must collaborate to uphold the interests of developing nations and promote a more equitable international order.

India and New Initiatives at BIMSTEC Summit

Sub Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

At the 6th BIMSTEC Summit held in Bangkok, **Prime Minister Narendra Modi unveiled more than 20 major initiatives aimed at enhancing regional connectivity, economic cooperation, security, and human development among the seven BIMSTEC nations.**

More on News

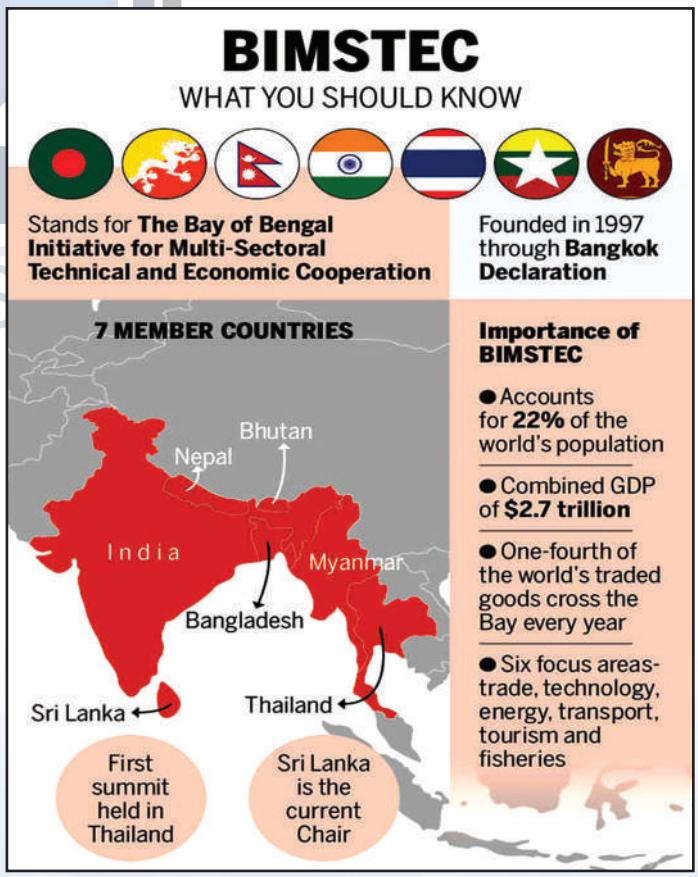
- Describing BIMSTEC as more than just a regional grouping, the PM hailed it as a ***"model for inclusive development and collective security."***
- ***"BIMSTEC serves as a vital bridge between South and Southeast Asia and is emerging as a powerful platform for regional prosperity,"*** PM Modi said during his address.
- He welcomed the recent **implementation of the BIMSTEC Charter** and expressed confidence that the adoption of the **Bangkok Vision 2030** would accelerate shared progress in the Bay of Bengal region.

Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)

BIMSTEC is a regional multilateral organisation established on 6th June 1997 through the **Bangkok Declaration.** Headquartered in **Dhaka, Bangladesh,** it serves as a platform for **cooperation among South Asian and Southeast Asian countries bordering the Bay of Bengal.** The organisation aims to foster economic growth, regional connectivity, and collaboration across various sectors. It comprises seven member states: Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand.

Major Initiatives

- **Strengthening Security and Institutional Mechanisms:** PM Modi announced the **institutionalisation of a BIMSTEC Home Ministers' mechanism** to tackle issues such as terrorism, cybercrime, drug trafficking, and human trafficking.
- **Enhancing Connectivity and Trade:** Highlighting the importance of integrated development, **PM Modi proposed stronger physical, digital, and energy connectivity. Key initiatives include:**
  - **Interlinking India's Unified Payments Interface (UPI)** with payment systems of other BIMSTEC countries to enhance trade, tourism, and commerce.
  - Accelerated **efforts toward electric grid interconnection** to improve energy security across the region.
  - Creation of a **BIMSTEC Chamber of Commerce** and an annual Business Summit to strengthen trade and business ties.
  - A **feasibility study on local currency trade** among member nations.
- **Maritime and Disaster Preparedness:** Acknowledging the shared priority of securing the Indian Ocean, Modi proposed a **Sustainable Maritime Transport Centre** focused on research, innovation, and policy coordination.



- He also announced the establishment of a **Centre of Excellence for Disaster Management** in India to improve disaster preparedness and relief efforts.
  - A joint exercise involving disaster management authorities will also take place later this year.

- **Focus on Health, Agriculture, and Traditional Medicine:** Underlining India's holistic approach to public health, PM Modi said India will support **cancer care training across BIMSTEC countries and establish:**
  - A **Centre of Excellence in Traditional Medicine** for research and knowledge-sharing.
  - A **Centre of Excellence in Agriculture** to enhance knowledge exchange, research, and capacity building.
- **Cooperation in Space, Education, and Skill Development:** PM Modi proposed significant steps in space cooperation, including:
  - Ground station establishment for training and satellite development.
  - Use of remote sensing data across member nations.
  - To enhance human capital, India is launching the **BODHI initiative (BIMSTEC for Organised Development of Human Resource Infrastructure),** offering training to 300 young individuals from BIMSTEC countries annually. Additional educational opportunities include:
    - Scholarships at India's Forest Research Institute and Nalanda University.
    - An annual training programme for young diplomats.
- **Cultural and Youth Engagement:** India will host the **first BIMSTEC Traditional Music Festival and the Young Leaders' Summit** later this year.
  - New programmes like the **BIMSTEC Hackathon and Young Professional Visitors Programme** will be launched to encourage innovation and collaboration.
- **Sports Initiatives:** India also proposed to host a **BIMSTEC Athletics Meet in 2025** and announced plans to organise the inaugural **BIMSTEC Games in 2027**, marking the 30th anniversary of the grouping.
- **Humanitarian Support and Solidarity:** Expressing condolences over the recent earthquake in Myanmar and Thailand, PM Modi reaffirmed India's role as a first responder during crises.
  - He noted India's timely aid delivery to Myanmar and reiterated the importance of disaster readiness.

With these comprehensive initiatives, the India Prime Minister reaffirmed India's commitment to a prosperous, secure, and interconnected Bay of Bengal region through the BIMSTEC platform.

MAHASAGAR Vision

Sub Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

Marking the tenth anniversary of its **SAGAR doctrine—Security and Growth for All in the Region**—India has elevated its maritime strategy with the launch of the **MAHASAGAR vision.**

More on News

- Announced by Prime Minister Narendra Modi during his visit to Mauritius in March 2025, the initiative stands for **"Mutual and Holistic Advancement for Security and Growth Across Regions"** and seeks to reinforce India's role as a key maritime player in the Indian Ocean Region (IOR).

AIKEYME 2025: Strengthening Maritime Partnerships

- In a major step toward operationalising MAHASAGAR, India is set to conduct **AIKEYME (Africa-India Key Maritime Engagement),** a six-day joint naval exercise from April 13 to 18, in collaboration with the **Tanzania People's Defence Force (TPDF).**
- The exercise, hosted in Tanzania, underscores the growing strategic importance of the **Western Indian Ocean Region (WIOR)** in India's foreign policy.
- Defence Minister Rajnath Singh will inaugurate the inaugural edition of AIKEYME, which will feature participation from ten African nations: Comoros, Djibouti, Eritrea, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, and co-host Tanzania.

AIKEYME will be Conducted in Two Phases

- **Harbour Phase:** This will feature tabletop and command-post exercises focused on piracy response, information sharing, seamanship training, and **Visit, Board, Search, and Seizure (VBSS) operations.**
- **Sea Phase:** Naval forces will engage in seamanship evolutions, search and rescue drills, small-arms firing, VBSS drills, and helicopter operations.

Indian Ocean Ship (IOS) Sagar Deployment

- Alongside AIKEYME, India will also launch the **Indian Ocean Ship (IOS) Sagar initiative** to deepen maritime collaboration with IOR nations.
  - Under this initiative, **INS Sunayna, an Indian Navy offshore patrol vessel, will be deployed in April 2025 to the southwest Indian Ocean for over a month.**

- The mission will feature a **multinational crew comprising personnel from India and nine other countries:** Comoros, Kenya, Madagascar, Maldives, Mauritius, Mozambique, Seychelles, Sri Lanka, and South Africa.
  - The deployment includes **scheduled port calls in Dar es Salaam, Nacala, Port Louis, Port Victoria, and Malé, along with joint surveillance of the exclusive economic zones (EEZs) of Tanzania, Mozambique, Mauritius, and Seychelles.**

Training and Capacity Building

- In preparation for both AIKEYME and IOS Sagar, a **two-week intensive training program is being conducted** at a naval professional school in Kochi.
- Officers from participating and friendly nations are undergoing at-sea training, watchkeeping duties, and whole-ship exercises aligned with their national requirements.
  - These personnel will also observe the harbour phase of AIKEYME in Dar es Salaam.

India-Africa Maritime Cooperation: A Decade in the Making

- India's commitment to African maritime security has grown steadily since Prime Minister Modi's 2018 address to the Ugandan Parliament, where he outlined **ten guiding principles of engagement with Africa—security in the Indian Ocean being a key pillar.**
- India has conducted numerous joint operations with African navies, particularly in **anti-piracy efforts.**
- In 2018, **Indian warships took part in Exercise IBSAMAR-VI** with the South African and Brazilian navies.
- Additionally, Indian vessels have regularly patrolled waters near Seychelles, Mauritius, Reunion, Madagascar, and Comoros.
- India also hosts the biennial **Milan Exercise,** which in 2024 saw a record 53 navies participate in Visakhapatnam, including 16 African nations.

Enhancing Communication and Response Capabilities

- A key element of interoperability is seamless communication. To facilitate this, **India launched the NISHAR communication terminal in 2024,** linking navies of friendly partner countries and enabling real-time coordination on maritime threats like piracy, trafficking, and illegal fishing.
- India has also reinforced its **Humanitarian Aid and Disaster Relief (HADR) capabilities,** consistently acting as the region's first responder.
- A significant milestone in 2024 was the commissioning of a new airstrip and jetty on Agalega Island (Mauritius), enhancing India's ability to deliver rapid aid and assistance.

Free and Open Indian Ocean Region

- Positioned at the crossroads of major maritime routes, the **Western Indian Ocean is increasingly becoming a hub of strategic competition and maritime challenges, including piracy and threats to commercial shipping.**
  - AIKEYME seeks to address these issues through collective preparedness and cooperation.
- **India envisions making AIKEYME a biennial event, with future editions** potentially involving West African nations.
  - By fostering regional security and capacity-building, India aims to position itself as a "preferred security partner" and "first responder" in the Indian Ocean Region.

Derived from Sanskrit, the name **"AIKEYME" symbolises unity, reflecting India's broader goal of promoting a free, open, and inclusive maritime environment through its MAHASAGAR vision.**

BRICS Pay

Sub Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

The BRICS nations, led primarily by China and Russia, are developing an **independent and decentralised payment system known as "BRICS Pay."**

More on News

- This initiative aims to **enable BRICS countries to trade using their own national currencies,** thereby **reducing dependence on the US dollar.**
- In collaboration with their BRICS partners, the **finance ministries and central banks of Russia and China are drafting a report outlining recommendations** to improve the international financial system.
- This report could lead to the **creation of a multilateral digital payment and settlement platform** designed to integrate the financial markets of BRICS member states and facilitate increased trade.

SWIFT System

The **Society for Worldwide Interbank Financial Telecommunications,** is a **secure messaging network used by financial institutions to facilitate international money and security transfers.** It acts as a **messenger between banks,** sending payment instructions rather than transferring funds directly. **SWIFT does not hold or manage client accounts or assets.** The headquarters of the SWIFT is located in **La Hulpe, Belgium**.

Features

- **Use of CBDCs:** A key feature of this system is the **use of central bank digital currencies (CBDCs)** issued by BRICS nations, **with their value pegged to national currencies.**
- **Decentralised:** The digital settlement and payment platform is intended to be decentralised, **ensuring that no participant has the authority to restrict others' actions.**
- **Aligning Legislative Frameworks:** If approved by Russia and China, the initiative will require BRICS countries to align their legislative frameworks **to implement the system effectively.**
- **Single Currency:** Additionally, discussions are underway about establishing a single currency for BRICS countries, though the trend remains focused on increasing the use of national and digital currencies, including the digital Russian ruble and the digital Chinese yuan.

US Response and Trump's Warning

- The BRICS plan to establish a digital asset platform for cross-border settlements and explore a new currency alternative to the US dollar has **reportedly provoked a strong response from US President-elect Donald Trump.**
- He **warned BRICS nations, including India, of a potential 100% increase in tariffs** if they continued their efforts to reduce reliance on the dollar.
- Trump asserted that **should BRICS proceed with their plans, they risk losing access to US markets.**
  - **His warning came shortly after the Russian Senate approved legislation defining the tax framework for cryptocurrencies, a step toward legalising digital assets in Russia.**
- Despite Trump's threats, **leaders from Russia, India, and China have yet to issue a response.**
  - The US's use of the dollar as a financial weapon through sanctions has prompted both China and Russia to seek alternatives, particularly in light of the ongoing US-China technology war and Western sanctions on Russia due to the Ukraine conflict.

BRICS Pay: A Digital Future

- Since March 2024, BRICS nations have been **actively working on developing their digital payment network.**
- BRICS Pay, designed to facilitate **cross-border transactions using digital assets,** is **expected to incorporate blockchain technology to ensure security and efficiency.**
- The **system aims to function alongside a new secure messaging platform**, **mirroring the role of the SWIFT system** currently used for international banking transactions.
- With BRICS Pay, countries including Russia, China, Brazil, South Africa, India, Saudi Arabia, the UAE, Egypt, and Ethiopia **plan to create an international payment infrastructure independent of Western influence.**

Strategic Impact of BRICS Pay

- **Challenge to Dollar: Russia has already approved the use of digital assets in international payments,** allowing BRICS countries to bypass Western sanctions through a decentralised mechanism supporting multiple currencies.
  - This development is **expected to enhance BRICS' economic influence and accelerate the establishment of a supranational currency,** posing a direct challenge to the US dollar's dominance.
- **Trade:** One of the core objectives of BRICS is to **facilitate trade in national currencies.**
  - Currently, **95% of trade between Russia and China is conducted in rubles and yuan,** strengthening financial stability and resilience against external economic shocks.
  - The proposed BRICS digital payment platform is **intended to weaken the monopoly of the Western-dominated SWIFT system** by introducing an alternative based on digital currency technology.

Prelims

Ottawa Convention

Sub Topic: *Bilateral, regional and global groupings and agreements involving India and/or affecting India's interests.*

Context:

Several **European** countries have recently announced plans to withdraw from the **Ottawa Treaty** banning anti-personnel **landmines** in response to growing security concerns, particularly regarding potential aggression from **Russia**. These decisions mark a significant shift from decades of international disarmament efforts and have raised concerns among **activists** and humanitarian groups.

Exiting Countries

- **Countries Involved: Poland**, **Finland**, **Estonia**, **Lithuania** and **Latvia**
- **Geographical Context:** These countries all border **Russia** and are members of **NATO** (with the exception of some non-NATO states) and the **Baltic** region.
  - They are responding to what they describe as an increased threat from **Russia**.
- **Notable Exception: Norway** remains in the treaty because it believes in maintaining the international stigma against **landmines** despite heightened security concerns.

Ottawa Convention (Mine Ban Treaty)

- A **legally binding international treaty adopted in December 1997** and **effective from March 1999**, aimed at eliminating **anti-personnel landmines**.
- It **prohibits their use**, **stockpiling**, **production**, and **transfer**, and **includes provisions for victim assistance**, **mine clearance**, and **international cooperation**.
- **Signatories:** 164 countries (as of 2024)
- **Non-members:** India, US, Russia, China, Israel
- ***India cites security concerns*** *due to porous borders and insurgencies.*
- **Objective: To end human suffering caused by landmines**, prevent civilian casualties post-conflict, and **support victim rehabilitation and land restoration**.

Reasons for Withdrawal

- **National Security and Defence:** The primary reason is to **shore up defences** and deter potential **Russian** aggression.
  - The moves are partly driven by the perception that **Russia** might rearm while these countries remain bound by the treaty.
- **Equal Footing in Arms Control:** By leaving the treaty, these countries aim to be on a more **equal footing** with nations like **Russia, the US, China, India,** and **Israel**, which have not signed or ratified the treaty.
- **Military Autonomy:** Resumption of **landmine** production and stockpiling is seen as a way to enhance national security measures.

Implications of Withdrawing from the Treaty

- **Resumption of Landmine Use:** Countries exiting the treaty will be allowed to produce, use, and stockpile **landmines** once again.
- **Impact on Global Disarmament:** This decision challenges decades of progress made in global arms control and could potentially lead to more nations reconsidering their stance on **landmines**.
  - It may undermine international consensus on disarmament and the broader **International Humanitarian Law (IHL)**.
- **Concerns for Civilian Safety: Activists** and organisations such as the **International Committee of the Red Cross (ICRC)** have raised alarms about the risks **landmines** pose to civilians, often remaining active long after conflicts end.
  - The humanitarian implications include long-term dangers to civilian populations, as seen in regions like **Ukraine**.

Funding Cuts and Humanitarian Impact

- **Reduced Demining Efforts:** Global demining efforts have been hampered by **crippling** funding cuts from the **US**, which historically provided a significant portion of the international support for mine clearance.
- **Consequences for Victims:** The treaty not only banned **landmines** but also included provisions to assist victims of these weapons. Withdrawal could impact future support for those injured or affected.
- **Shift in International Priorities:** The changes come amid broader shifts in international military strategies and aid programs, reflecting a move towards national defence over international humanitarian obligations.

One Sandbox For All: How Can India Shape the Future of FinTech

Introduction

India is moving very fast in the world of technology. One of the most exciting changes is happening in the way people use money. Today, people are paying with mobile phones, transferring money instantly, and using apps to borrow or invest money. All of this is part of what is called "fintech," which is short for financial technology. It is the mix of finance (money) and technology (digital tools and apps).

But while fintech is growing very quickly, the rules that manage and guide it are not keeping up. These rules are made by different government bodies, and they are not working together properly. This is where the idea of a "regulatory sandbox" becomes important. It is a safe and controlled place where new fintech ideas can be tested without facing all the usual strict rules at the beginning.

In his article, "***Powering Fintech: The Case for Unified Regulatory Sandboxes in India***" (ORF, April 16, 2025), **Debajyoti Chakravarty** explains that India has many different sandboxes run by different regulators, but they are not connected to each other. This makes life difficult for new companies and slows down innovation. His main argument is simple but powerful: all these sandboxes should be brought together into one unified system so that fintech in India can grow better, faster, and safer.

What Is a Regulatory Sandbox?

Imagine a sandbox in a playground. Children can try out new games in a safe place where they will not get hurt. A regulatory sandbox works in the same way, but for companies that want to test new financial products and services.

For example, a startup might want to create an app that gives small loans to farmers in remote villages using just a smartphone. Normally, this company would need to follow many difficult and expensive rules right from the start. But in a sandbox, it can try the app with a small group of users and under the watch of regulators. If something goes wrong, the damage is limited. And if it works well, the company can later go fully into the market.

As Debajyoti Chakravarty points out, sandboxes give companies a chance to experiment without fear of punishment. They allow innovation to happen in a responsible way. The United Kingdom and Singapore were among the first countries to start using sandboxes in this way, and now about 60 countries have them.

The Problem in India: Too Many Sandboxes, Not Enough Unity

India has more than one regulatory body managing its financial system. The Reserve Bank of India (RBI) looks after banks and payments, the Securities and Exchange Board of India (SEBI) controls the stock markets, the Insurance Regulatory and Development Authority of India (IRDAI) manages insurance, and the International Financial Services Centres Authority (IFSCA) handles global financial services.

Each of these regulators has created its own regulatory sandbox. But they all work separately. They have different rules, different time limits for testing, and different kinds of companies they accept. Some allow foreign companies; others do not. Some allow live testing, others prefer computer-based testing first. This is like having four different types of playgrounds, but no way to move from one to another easily.

This system makes it very hard for companies that are trying to build something new across different financial sectors. For example, a startup that offers both insurance and investment services will need to talk to both IRDAI and SEBI. It might even have to go through two different sandbox applications. This creates more paperwork, longer delays, and higher costs. As Chakravarty explains, this fragmented system "limits the potential of regulatory sandboxes to promote knowledge-sharing around innovation".

What Happens When Regulators Work Together?

The Organisation for Economic Co-operation and Development (OECD) says that good regulation comes from teamwork. "Achieving good regulatory outcomes is almost always a cooperative effort," it explains. In other words, regulators must talk to each other and coordinate their actions. This is especially true in fast-moving areas like fintech, where new ideas often cross over many financial sectors.

Chakravarty suggests that India needs to form a single team to manage all the sandboxes. This team would be called the Cross-Sector Fintech Oversight Committee. Its job would be to bring together all the regulators—RBI, SEBI, IRDAI, and IFSCA—so that companies can enter one sandbox and get help from all the necessary regulators in one place.

This idea is supported by many experts. In the book *Understanding Regulation*: Theory, Strategy, and Practice (2nd edition, Oxford University Press, 2012), Baldwin, Cave, and Lodge explain that when regulators do not talk to each other, it causes what is called regulatory duplication and even regulatory

gaps. This means that some things are repeated unnecessarily, and other important areas are missed altogether.

What Would a Unified Sandbox Look Like?

If India wants to truly support its fast-growing fintech industry, then it must build a smarter system where all financial regulators work together under one roof. Debajyoti Chakravarty paints a clear picture of how this new system could work. First, there should be something called **unified entry standards**. This means that all fintech companies, no matter which part of finance they work in—banking, insurance, investing, or international services—should face the same basic requirements when they want to enter a regulatory sandbox. These requirements might include proving that their idea is safe for customers, that it has a clear benefit, and that the company is stable and serious. Right now, each regulator has its own rules, which confuses companies and slows things down. If these were the same across the board, companies would have a much smoother path.

Second, Chakravarty suggests creating a **fast-track licensing system**. This would allow new fintech companies to quickly get approval to test their ideas. At the moment, getting a license in finance can take months or even years, with lots of paperwork and long waiting times. But if the process was simplified and speeded up—without losing safety—it would encourage more startups to bring their ideas to the market and start helping people sooner. The faster good ideas are tested, the faster they can grow and benefit society.

Next comes the idea of **cross-border collaboration**. Many fintech companies want to grow beyond India and reach customers in other countries too. To do that, India needs to work closely with foreign regulators and create partnerships. This would allow a product that is successful in India to also be tested and launched in places like Singapore, the United Kingdom, or Africa. It is like having a passport for innovation. IFSCA, one of India's regulators, is already doing some of this. Chakravarty wants this to become a regular feature across all regulators.

Another important part of a unified sandbox would be **data sharing and learning**. When fintech companies test new products in sandboxes, they collect a lot of information—what works, what does not, and what customers like or dislike. If regulators share this information with each other, they can all learn faster. This way, they do not repeat the same mistakes, and they can improve their policies based on real evidence. It also helps new companies to plan better by learning from the past.

Finally, there should be **public reports or whitepapers** that explain what is being tested, what the results are, and what happens next. These reports should be written in a way that is easy to understand—not just for experts but also for ordinary people and students. Publishing these findings will make the whole process more transparent. People will trust the system more, and other startups will know what kinds of ideas are welcome. This is how regulation becomes a shared journey instead of a secret maze.

Why Does This Matter for Startups and Everyday People?

Startups are the small companies with big ideas. But these companies often struggle when they have to deal with too many rules or too many regulators. If the system is too confusing or slow, they may give up or go to another country.

Also, everyday people like farmers, small shopkeepers, and students are the ones who benefit most from fintech. Digital wallets, loan apps, and mobile banking help people who do not have easy access to traditional banks. But for these products to reach them, startups need support and clear rules.

In *The **FinTech Book*** (Willey, 2016), **Maneesh Bhandari** in the chapter "***India and the Pyramid of Opportunity***" explains that nearly 50% of bank accounts opened under the Indian government's Jan Dhan Yojana have zero balances (pp. 82-83). That means people have accounts, but they are not using them. Fintech can solve this problem by offering better services—but only if they are allowed to test and grow easily.

Lessons from Other Countries and Crises

Experts from around the world support Chakravarty's plan. Julia Black, a respected scholar, studied what went wrong during the 2008 financial crisis. She says that many of the problems were caused because regulators worked alone and did not see the full picture. In her article "***Paradoxes and Failures: 'New Governance' Techniques and the Financial Crisis***" (***The Modern Law Review***, 75.6, 2012) she writes, "*Regulation is a complex and multi-dimensional activity*," (p. 1056). If one part of the system fails, the whole system can be at risk.

India should learn from these past mistakes. The goal should not be just to build more sandboxes, but to build connected and smart sandboxes that help everyone—startups, customers, and regulators.

From Fragmentation to Integration: Making Innovation Safe

Another book, ***The Palgrave Handbook of FinTech and Blockchain*** (Palgrave Macmillan, 2021) edited by **Maurizio Pompella Roman Matousek** talks about the importance of giving companies space to experiment: the sandbox "requires some tolerance for trial and error. A sandbox would promote the objectives of secure the fairness, inclusion and transparency that are parts of core principles of banking regulations" (p. 5). But it also warns that sandboxes need expert supervision. If different regulators give different rules or do not talk to each other, companies can get confused or misuse the system. This is why Chakravarty's call for a single oversight body is so important. It would make sure that everyone is following the same plan and learning from the same experiments. He is not saying that we

should remove all rules. Instead, he wants rules that are helpful, easy to understand, and able to change when needed. This is called **responsive regulation**, and it means that regulators can tighten or loosen rules depending on how companies behave.

What Happens When Things Go Right?

If India can unify its sandboxes, many good things can happen:

- Startups will find it easier to launch new ideas.
- Customers will get access to better, safer financial tools.
- Regulators will learn faster and make better decisions.
- India can become a global leader in fintech, attracting investors and talent from around the world.

As Dirk Zetzsche and his fellow experts say in the article "Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation" (*Fordham Journal of Corporate & Financial Law* 23.1, 2017), sandboxes are tools of smart regulation" not destinations" (p. 101). That means sandboxes are not the final goal. They are just the starting point to build something bigger—an economy where technology and money work together to help people live better lives. A good sandbox system is like planting a garden where new ideas can grow into useful services, strong businesses, and smart policies. And when that happens, everyone—from a small farmer in Bihar to a college student in Bengaluru—wins.

Conclusion: Building a Smarter Future, Together

India's fintech sector is one of the most exciting parts of its growing economy. But for this sector to reach its full potential, it needs more than energy and ideas. It needs clear rules, smart systems, and a team effort among all regulators.

Debajyoti Chakravarty's proposal for a unified regulatory sandbox is not just about fixing problems—it is about unlocking opportunities. By bringing together different regulators under one system, India can create a world-class testing ground for new ideas in finance. This is not only good for businesses. It is also good for everyday people who need better access to money, savings, insurance, and investment. The way we design and use rules shapes what kind of future we build.

India now has the chance to build a future where fintech is not only fast and fancy—but also fair, inclusive, and safe. And that future begins with one sandbox for all.

One Treaty to Rule Them All: Why India Needs a Single, BIT

Introduction: Why Investment Treaties Matter

When countries want to trade with each other or invest in each other's economies, they often sign special agreements called bilateral investment treaties (BITs). These treaties are like rulebooks. They tell investors and governments how to behave. For example, a BIT may promise that a foreign company will not be unfairly treated, and that it can take disputes to international courts if needed. In return, it also protects the host country's right to make laws in areas like health, environment, and safety.

India has signed many such treaties since the 1990s. But in recent years, it has faced a problem. Some of these BITs allowed foreign companies to sue India in international tribunals—even when India was simply trying to protect public interests. This led to a big rethink. In 2015, India came up with a new model BIT—a kind of master template to guide all future BITs.

Now, some experts suggest that India should adopt two different model BITs: one for countries where it receives investment (as a capital importer), and another for countries where it invests money (as a capital exporter). But not everyone agrees. In fact, many legal scholars warn that this "two-BIT" idea is dangerous and confusing. This essay argues that adopting dual BIT models would create legal ambiguity, harm India's global standing, and deter investors; and that a unified, balanced treaty ensures stability.

BITs Are More Than Just Contracts

A key reason why India should not have two different BIT models is that BITs are not like everyday business contracts. As explained in ***Principles of International Investment Law*** (3rd edition, Oxford University press, 2022) by **Dolzer**, **Kriebaum**, and **Schreuer**, BITs are part of a wider international legal system. They are not simply tools to attract investment—they are instruments of legal order that shape global rules and expectations. The authors say that the requirement of "stability and consistency" is essential to the rule of law in the context of international investment (p. 205). This means that if a country like India starts creating different rules for different partners, it will look inconsistent. Investors and other countries may not trust it. They may worry that India changes its rules whenever it suits its own interests. They also explain that investment treaty arbitration seeks to protect values such as legal certainty, the rule of law and good governance. When India sends mixed messages through two separate BIT models, it undermines these very values. And international courts may interpret India's changing behaviour in a way that works against India in disputes.

Ranjan's Warning: Do not Mix Messages

Professor Prabhash Ranjan, in his article "***The BIT Model India Needs***" (*Indian Express*, April 16, 2025), makes this point very clearly. He critiques the proposal made by **Rajesh Kumar Singh** and **Karamjeet Kaur** (*IE*, March 17, 2025, "***Thinking a BIT differently***") to adopt two different BIT models. According to Ranjan, this approach seems logical at first but is ultimately unwise. Why? Because India's role in the global economy is not fixed. For example, in 1994, India signed a BIT with the UK as a capital importer. But by 2021–2022, India had become a major investor in the UK. Ranjan explains that India also sends and receives capital from many other countries. So, dividing countries into neat groups of importers and exporters does not work anymore.

Ranjan also points out a serious risk: inconsistency in legal principles. For example, India's 2015 model BIT requires investors to first go through local courts for five years before turning to international tribunals. This gives India more control over disputes. But if India were to offer easier arbitration access to investors in other treaties, that would create two standards. This would show that India does not have a stable legal policy. It may even weaken its position in multilateral negotiations like those at the **United Nations Commission on International Trade Law** (**UNCITRAL**).

Nedumpara's Argument: BITs Shape India's Global Identity

The book ***India's Bilateral Investment Treaties 2.0*: *Perceptions, Emerging Trends, and Possible Architecture*** (Springer, 2024), edited by **James Nedumpara**, agrees strongly with **Ranjan**. Nedumpara argues that BITs help shape a country's legal identity and reputation. They are not just one-time deals. If India starts creating different models for different partners, it could be seen as unprincipled and unreliable. According to the book, international investment agreements do more than just define the rights and responsibilities of investors and states—they also help shape how India is perceived in the global legal and economic system. Countries and investors closely observe how India conducts itself across all its treaties. If India adopts different treaty standards for different partners, it may be seen as inconsistent or self-serving. This could prompt other countries to demand similar concessions, ultimately weakening India's leverage in future negotiations.

Another important point is the MFN clause (**Most-Favoured Nation**). If one treaty gives a benefit, others may ask for it too. So, even if India wants to keep a defensive model with one country, that country may use MFN to ask for the better deal India gave to someone else. As the book explains, this strategy could expose India to broader obligations than intended and defeat the very rationale behind a dual-model strategy.

The world economy today is complex. India is not just a developing country anymore. It invests abroad and receives investment. As the book ***India's Bilateral Investment Treaties 2.0*** puts it, the old idea of dividing countries as capital importers or capital exporters is increasingly outdated. India is now a dual-status country. For example, it both invests in and receives investments from countries like the UK, Germany, and Singapore. This makes it harder to apply a simple two-model rule. If India sticks to a single, consistent model BIT, it will be easier to manage relationships with all these countries. It also makes India look like a mature and responsible global actor. The book suggests that a modern BIT should include clear definitions, protections for public interest, and fair dispute resolution. This balanced model protects both investors and governments. It matches global trends and makes India's policies more predictable.

Sornarajah's Perspective: Do not Be a Push-Over

In *The* ***International Law on Foreign Investment*** (**Cambridge University Press**, 2010), **M. Sornarajah** explains that many older BITs were designed to protect investors—mainly from rich countries. He argues that these treaties were not neutral. Instead, they were created "to ensure investment protection" and favoured powerful capital-exporting states (p. xv). Sornarajah warns that if developing countries are not careful, they can lose control over important laws. For example, if a country wants to protect the environment or raise labour standards, foreign companies might sue the government under the BIT. He explains that ISDS mechanisms have become a means of undermining state regulatory power.

However, he also notes that things are changing. New BITs are including protections for the public interest: "There is an evident retreat from the perception that investment protection is the only purpose of the investment treaty" (p. xvi). This means that more countries are moving towards balanced treaties that allow them to protect their people while still welcoming investment.

India should not go backwards by adopting a messy two-model system. Instead, it should follow this global movement and design one good BIT model that meets all its needs.

Learning from Others: Poulsen's Research

Lauge N. Skovgaard Poulsen, in the article "***Bounded Rationality and the Diffusion of Modern Investment Treaties***" (***International Studies Quarterly***, March 2014, Vol. 58, No. , pp. 1-14), gives a useful history lesson. He shows how countries like South Africa signed early BITs without really understanding them. According to him, "[South Africa's] government wanted to believe the treaties 'worked', which in turn had an impact on how it sought and processed information" (p. 8). But later, South Africa faced real problems. Investors used the treaty rules to challenge South Africa's policies, including those meant to fix inequality after apartheid. Only then did South Africa realise it had made a mistake. The government started cancelling old BITs and rewriting them carefully.

Poulsen warns that once a country shows a pattern of inconsistent treaties, it becomes hard to change direction. International tribunals use that pattern to judge the country's future cases. So, if India starts using two very different models, it could end up setting a dangerous precedent that will hurt it later.

A Smarter Solution: One Strong, Balanced BIT

All the evidence points to one conclusion: India should not adopt two separate BIT models. The risks—legal confusion, damaged reputation, loss of bargaining power, and reduced investment—are too high. Instead, India should focus on creating a single, balanced model that is fair to investors but also protects India's right to make laws for public good.

Prabhash Ranjan, in his book ***India and Bilateral Investment Treaties: Refusal, Acceptance, Backlash*** (Oxford University Press, 2019), calls for a model that is balanced, fair and equitable and protects India's regulatory space without giving carte blanche to the state to act arbitrarily. He recommends clear rules, well-defined exceptions, and proper procedures for dispute settlement. This would make India's treaties both strong and fair. Such a model would not only build investor trust but also allow India to stand tall in global forums. It would help India shape the future of investment law, rather than be pushed around by others.

Conclusion: One Model, Many Wins

In today's world, international investment is about much more than money. It is about rules, trust, and global cooperation. India has a big role to play—but to do that, it needs to be consistent, principled, and smart.

Having two different BIT models might seem flexible, but it is actually confusing and dangerous. It weakens India's legal position and sends the wrong message to the world. As Prabhash Ranjan and other leading experts agree, the solution lies in one strong, balanced BIT model. That is the path to long-term stability, fairness, and international respect.

The Power of Diffusion: Technology, Institutions, and Development in a Changing World

Introduction: Rethinking Technological Power

The common belief that national power in the modern world arises from technological innovation—particularly through dominance in cutting-edge sectors like semiconductors, electric vehicles, or artificial intelligence—has shaped how states design their development strategies. However, this view is increasingly being challenged by scholars and thinkers who argue that a nation's true strength lies not in being first to invent, but in its ability to diffuse technologies widely and effectively across its economy and society. One of the most compelling formulations of this argument comes from **Pratap Bhanu Mehta**, in his interpretation of **Jeffrey Ding's *Technology and the Rise of Great Powers*** (**Princeton University Press**, 2024). Mehta highlights the importance of institutional and systemic capacity in enabling technologies to be adapted and applied across various sectors, thereby transforming economies at large. The idea that "***diffusion is destiny***", as Mehta puts it, demands a fundamental rethinking of how development, capability, and power are understood. This essay explores and reinforces Mehta's thesis by drawing on other relevant scholarly works. The core argument of this essay is that the strength and success of a modern nation is determined not merely by invention but by the inclusiveness, adaptability, and institutional depth of its ability to diffuse transformative technologies across society.

The Nature of General Purpose Technologies and the Role of Institutions

Understanding why diffusion matters requires clarity on what constitutes **General Purpose Technologies** (**GPTs**). These are technologies that have broad applicability, are capable of ongoing improvement, and spark major economic and social changes across multiple sectors. The **steam engine**, **electricity**, and **computers** are all classic examples. **Lipsey**, **Carlaw**, and **Bekar**, in ***Economic Transformations: General Purpose Technologies and Long-Term Economic Growth***. (**Oxford University Press**, 2005), describe GPTs as technologies whose power lies in their ability to trigger widespread structural transformation. However, they caution that this potential is only realised when a "facilitating structure" is present. (Lipsey, et al., p. xvii). As they assert, GPTs cannot produce their full benefits unless and until a facilitating structure emerges that is suited to them. This structure includes educational systems that develop the necessary skills, organisational norms that support experimentation, and institutional flexibility that allows sectors to adapt to change. Without these supports, GPTs remain siloed or under-utilised, leading to stagnation rather than transformation.

This institutional view of technology aligns perfectly with Mehta's insistence that innovation clusters alone are insufficient. In his reading of Ding, he argues that long-term power is not built by dominating specific technological sectors but by building systems—schools, governance mechanisms, financial frameworks—that allow those technologies to be embedded in the everyday workings of the economy. These ideas directly challenge industrial strategies that chase first-mover advantage or sectoral leadership without addressing the broader capability question.

History's Lesson: The Delayed Power of Electricity

Paul A. David's work "***The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox***" (*The American Economic Review*, 1990, pp. 355–361) provides a compelling historical example of how transformative technologies fail to deliver rapid impact without proper institutional adaptation. David explores why the electric dynamo—despite being widely available by the late 19th century—did not produce immediate productivity gains. He shows that factories continued using older mechanical power systems for decades, partly because electrification required completely rethinking factory layout, job roles, and maintenance systems.

Organisational inertia and decentralised learning had slowed adoption: "*The transformation of industrial processes by electric*

power was long-delayed and far from automatic business" (David, p. 356). The technology was visible everywhere, but, as David notes, "*dynamos were to be seen everywhere but in the productivity statistics*" (p. 356). This history reinforces Mehta's argument that the mere existence of a technology does not imply national transformation. What matters is whether the society in question is able to build the necessary social and institutional scaffolding to support the use of that technology. Productivity gains, industrial shifts, and improved standards of living do not follow automatically; they are the result of careful planning, investment in human capital, and sustained structural reform.

Institutional Coordination and Varieties of Capitalism

The question of how institutions facilitate or inhibit technological diffusion is further explored in **PA Hall** and **D. Soskice's *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*** (Oxford University Press, 2001). They categorise countries into two broad types: Liberal Market Economies (LMEs), like the United States, which rely on market-driven coordination, and Coordinated Market Economies (CMEs), like Germany, which depend more on long-term relationships between firms, labour, and the state. These differences significantly shape how countries respond to new technologies. Hall and Soskice argue that "the capacities of firms to pursue distinctive strategies" depend critically on the ability to "coordinate with other actors in the economy" (Hall and D. Soskice, p. vi). This insight strongly supports Mehta's view that institutional adaptability is central to technological success. It also explains why certain countries, despite having similar access to technology, perform very differently in terms of diffusion and long-term development. Without supportive institutions—such as vocational training systems, stable labour markets, and access to capital—firms cannot integrate new technologies effectively. What looks like a failure of innovation may, in fact, be a failure of institutional design.

State Structure and Innovation at the Frontier

These institutional differences in coordinating economic activity help explain domestic variation in technological diffusion, but they also raise a broader question about the role of the state itself in fostering or hindering technological leadership. While Hall and Soskice focus on firm-level and systemic coordination within capitalist economies, Daniel Drezner's article "***State Structure, Technological Leadership and the Maintenance of Hegemony***" (***Review of International Studies***, 2001, pp. 3–25) expands the analysis to the macropolitical level, examining how different state structures shape national capacity for technological adaptation and resilience. **Daniel Drezner's** article "***State Structure, Technological Leadership and the Maintenance of Hegemony***" (***Review of International Studies***, 2001, pp. 3–25). He introduces a crucial geopolitical perspective by linking state structure to a country's ability to remain technologically competitive.

After contrasting centralised and decentralised governance systems, he concludes that decentralised systems are more resilient at the technological frontier because they allow experimentation and limit the damage from policy mistakes: "*Decentralised states are more likely to create an environment that fosters experimentation and rewards innovation*", and "*errors by one region are not replicated across the country*" (Drezner, p. 5). This perspective reinforces Mehta's criticism of centralised, mission-mode approaches to technology policy, which often fail to account for local needs and institutional readiness. In countries like India, where diversity in development levels, economic structures, and institutional capacity is vast, decentralisation may not only be more democratic but also more effective in promoting technological diffusion.

The Political Economy of Patience

One of Mehta's most profound insights is the mismatch between political expectations and the timeframes necessary for successful technological diffusion. Governments often prioritise high-profile investments in elite sectors that promise quick, visible returns, while neglecting the slower, less glamorous task of building the foundational capacity needed for widespread adoption. This political impatience overlooks the reality that transformative technologies rarely deliver immediate results; they require structural adjustments within firms, institutions, and entire sectors—processes that can take years or even decades. Moreover, when these adjustments are difficult, expensive, or face resistance from entrenched interests, the diffusion of technology is further delayed, undermining its potential to generate broad-based economic and social benefits. This mismatch leads to frequent policy failures, where countries try to leapfrog into high-tech sectors without first ensuring that the broader ecosystem—education, infrastructure, market access—is ready. Effective diffusion requires not just resources but also time, coordination, and a political culture that values long-term investment over short-term success.

Diffusion and Development: Lessons for India

India represents a vital test case for the theory that diffusion, rather than invention, drives sustainable development. While it has developed world-class innovation hubs and a globally respected digital services sector, much of the country remains disconnected from these advances. Mehta's concern is that India's current strategy—focused on flagship sectors and elite innovation centres—may replicate the mistakes of past industrial policies that failed to build deep and inclusive technological capability.

Sanjaya Lall offers critical insight into India's development challenge by challenging the assumption that technology is freely available to all countries and, within them, to all firms. In "***Technological Capabilities and Industrialisation***" (***World Development***, 1992, pp. 165–186), he argues instead that true technological advancement depends on building internal capabilities at the firm level—through sustained investment,

continuous learning, and adaptation to local conditions. This perspective closely aligns with Mehta's call for nurturing grassroots innovation and supporting "***engineers who tweak***", particularly in small towns and under-resourced sectors, to ensure that technology takes root beyond elite clusters. Complementing this view is a rethinking of industrial policy not as rigid, top-down planning but as a discovery process—an evolving collaboration between firms and governments. In such a model, both parties jointly explore costs, opportunities, and strategic directions, using feedback and evidence to adapt over time. This form of policy-making is particularly vital for a country as diverse and complex as India, where standardised approaches often miss the nuances of local realities. Together, these insights underscore the importance of a flexible, learning-oriented development model rooted in capability-building and responsive governance.

The **World Bank Policy Research Working Paper** "***Leading Dragons Phenomenon: New Opportunities for Catch-Up in Low-Income Countries***" (2012) by Chandra, Lin, & Wang) also points to a major opportunity for India. As China upgrades its industries, it is shedding millions of labour-intensive jobs, creating space for other countries to absorb these manufacturing roles. To catch "the jobs spillover from China" (Chandra et al., p. 2), the winner must implement credible economic development strategies that are consistent with its comparative advantage. For India, this means building the institutional capacity to attract investment, train workers, and integrate new industries into its broader economic system. Without these efforts, the opportunity may pass it by.

Conclusion: Building Capability through Diffusion

Across theoretical and empirical contributions, a single truth emerges with clarity and force: diffusion, not mere invention, is the foundation of sustainable technological and economic development. Mehta's interpretation of Ding's work provides a crucial corrective to innovation-centric development models. A range of perspectives from economic history, institutional economics, governance structures, and international development all reinforce this insight from different angles, highlighting how technological transformation depends not only on invention but also on the broader systems—social, political, and economic—that enable its diffusion and integration across sectors and societies.

In the case of India, these lessons are not abstract. They point to real and urgent policy changes: investing in broad-based education, supporting adaptive industrial ecosystems, reforming institutions for coordination, and resisting the allure of top-down technology showcases. As Mehta argues, national power in the 21st century will not be won by those who innovate first, but by those who learn how to integrate, adapt, and spread those innovations across their societies. If India can meet this challenge, it will not only strengthen its own economy but provide a model for other developing nations navigating a rapidly changing global order. In the final reckoning, diffusion is not just a process—it is the decisive test of a nation's developmental maturity.

Fixing the Foundations: Why India's Cities Need Better Governance

Introduction

India is one of the fastest urbanising countries in the world. Every day, thousands of people move from villages to cities in search of jobs, schools, hospitals, and better lives. As a result, cities like Delhi, Mumbai, and Bengaluru are growing very quickly. One might expect this growth to lead to cleaner, wealthier, and more organised cities. However, in reality, most Indian cities still struggle with problems such as water shortages, air pollution, poor housing, traffic congestion, and unfair access to services.

These issues persist even though the government spends a great deal of money on building infrastructure like roads, flyovers, metro systems, and smart city technologies. The fact that problems continue despite such efforts tells us something very important: India's urban challenges cannot be solved by construction projects alone. They are mainly caused by weak city governance, poor planning, and insufficient capacity at the local level.

This essay explains why Indian cities need a complete change in the way they are governed and planned. Instead of focusing only on buildings and technology, India must strengthen its institutions, empower local governments, and plan for cities as complex systems made up of people, spaces, and relationships.

Why Indian Cities Continue to Struggle

Cities are places where people live, work, travel, and interact. As more people come to cities, these places need more water, more roads, better waste management, and good housing. However, most Indian cities find it difficult to keep up with these needs. In "***Geographies of Urban Governance: Advanced Theories, Methods and Practices***" (Springer, 2015), the authors Gupta *et al*. describe this challenge in detail: "The expected, but also planned urban growth presents urban governing agents with major demands in particular in the area of housing (including utilities such as water, electricity), environmental health (sanitation, waste, air quality, pollution), infrastructure (including mobility), economic opportunities, and social and political inequality" (Gupta *et al*., p. 16). This quote highlights how cities are under pressure in many areas at once. It is not just about buildings; it is also about clean water, jobs, waste collection, and fairness in how resources are shared. When the people in charge cannot handle all these issues together, cities become messy and unequal. The quote also shows how managing a city is about connecting many different systems — housing, health, transport, and the economy — and doing so fairly for everyone. At the heart of this challenge lies the question of governance — the system that determines how these decisions are made, who makes them, and how resources are managed.

Understanding Governance: The Real Power Behind Cities

Governance refers to how decisions are made and who has the power to make them. It also includes how money is spent and how rules are enforced. In India, governance is often not clear or strong. Local governments do not have enough control over their cities. Much of the power still lies with state or central authorities, even though cities are supposed to govern themselves after the 74th Constitutional Amendment. Local governments are held accountable to national governments; however, national governments often take over responsibilities meant for local authorities. This means that city governments are not truly in charge of their cities. They are expected to do important tasks, but they do not have the authority or the money to do them well.

When decisions are made far away from the people they affect, it becomes harder to solve local problems. For example, a problem in a small neighbourhood may not be noticed by a state official sitting in a capital city. Hence, for cities to function properly, local governments must be trusted, empowered, and supported. However, empowering local governments is only part of the solution. Equally important is ensuring that city planning reflects the unique character and needs of each place.

Planning That Fits Each City's Needs

Planning a city is not like following a recipe. Each city has its own needs, people, geography, and culture. Unfortunately, in India, most city plans are based on a "one-size-fits-all" method. These plans are often copied from foreign cities or created by consultants who may not understand the local context. **Paul James** and **colleagues** in "***Urban Sustainability in Theory and Practice: Circles of Sustainability***" (Routledge, 2015) warn against such approaches: "We need a new paradigm that moves beyond the current narrow focus on growth-based productivity and high-technology 'solutions' . . . connecting globally debated principles with locally engaged practices" (James *et al.*, 2015, p. xv). This quote reminds us that cities should not chase growth or new technology without thinking about what people truly need. For example, building smart traffic lights may not help if there are no pavements for people to walk on safely. Real planning means working with local people, learning about their lives, and then making decisions together. But good planning alone is not enough. For any plan to succeed, it must be supported by strong institutions that can turn ideas into action.

Institutions Are Like the Muscles of a City

A city's success depends on its institutions — the departments, people, and systems that keep it functioning smoothly. When these institutions are weak or lack coordination, even the best plans are unlikely to succeed. It is the strength and capacity of urban governance that ultimately determines whether a city can sustain its quality of life and adapt effectively to change. This means that a city's ability to change and grow comes from how strong its institutions are. This strength does not only come from computers or equipment. It comes from well-trained staff, good communication, trust between departments, and the ability to learn from mistakes. Without these, plans remain on paper and do not turn into action. However, even strong institutions cannot function effectively if they lack the authority to act. This brings us to a deeper challenge in India's urban landscape — the limited power granted to city governments.

Local Governments Must Have the Power to Act

City governments need more than just responsibilities — they need power. Right now, many city governments in India have to ask permission from state governments to make decisions. In Chapter 1 of "***Critical Dialogues of Urban Governance, Development and Activism: London & Toronto***" edited by Bunce *et al*. (UCL Press, 2020), Susan Moore and colleagues explain this clearly: "*Municipalities . . . are always 'creatures of the Province'*" (Bunce *et al*., p. 10). In this quote, the word "creatures" means that city governments are not treated as equal partners. They are treated more like children. This makes it hard for them to solve problems quickly. If local leaders do not have the freedom to act or the money to spend, they cannot take care of their communities properly. Empowering city governments means giving them budgets, staff, and training. It also means letting them plan their futures, instead of forcing them to follow orders from far away. Yet even when cities are given new tools or technologies, challenges persist — revealing that empowerment must go beyond physical investments.

Why Infrastructure Alone Will Not Work

India has spent billions on infrastructure. There are new roads, airports, and digital apps. But many problems remain. Paul James explains why this is the case: "The establishment of high-tech industries… has overlaid older commodities trading… This process of globalising economically… has put tremendous pressure on the access of the poor to land and housing" (James *et al*., p. 38). This shows how development that focuses only on business and technology can push out poor people. When land becomes too expensive or areas are cleared for projects, people lose their homes. So, infrastructure must serve everyone — not just businesses or the wealthy. It must be fair, inclusive, and planned with care. Achieving this kind of inclusive planning requires listening to the very people who are most affected by these changes — the residents themselves.

Letting Citizens Help Build Their Cities

People who live in cities have an intimate understanding of their neighbourhoods. They know which drains frequently overflow, which schools lack proper facilities, and where public transport is most needed. Despite this local knowledge, many city plans

are developed without involving them—a missed opportunity for meaningful improvement. Involving residents in planning is not only a democratic practice; it is a strategic one. When citizens participate, plans reflect real needs and everyday experiences, making them more practical and effective. For instance, including residents in designing a waste management system increases the likelihood that they will sort their waste properly, as they feel ownership and understand the process. Participation turns good ideas into successful, lasting solutions. To truly benefit from such participation, however, cities must be viewed not as collections of separate systems, but as interconnected and dynamic environments where every part influences the whole.

Seeing the City as a Living System

Cities should not be seen as machines with separate, disconnected parts, but as living organisms where everything is interlinked. Water systems influence public health, road networks impact air quality, and education affects job opportunities. Understanding these connections is essential for effective city management. Real change depends on the continuous, collaborative efforts of people—leaders, planners, and communities—working thoughtfully and responsively. City governance must be flexible and inclusive, encouraging constant learning and adaptation. A successful city is not built through isolated projects but through the united actions of institutions, citizens, and policymakers, all working together to create a cohesive, equitable, and resilient urban environment.

Conclusion: A Foundation for the Future

India's cities are full of energy, creativity, and ambition. They are places where millions of people hope to build better lives. But these cities also face serious problems — from polluted air and unsafe water to overcrowded roads and unequal access to housing and services. Despite large investments in infrastructure, many of these problems continue. This is not because there is too little construction, but because the systems that run our cities are not working well enough.

For cities to truly improve, India must fix how they are governed. Local governments must have more power and resources. Institutions need to become more skilled, better organised, and able to learn and adapt over time. Planning must be based on the real needs of each city, not on generic models or expensive technologies. People must be included in decisions, and their voices must shape the future of their neighbourhoods. And most importantly, every part of city life — from transport to housing to the environment — must be treated as part of one big, living system, where everything is connected.

The future of Indian cities depends not just on buildings or technology, but on thoughtful planning, strong leadership, and fair governance. When cities are built on these strong foundations, they can become truly inclusive, sustainable, and inspiring places for everyone.

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