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DAILY PRELIMS NOTES COMPILATION
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Economy

Agrarian crisis: Landholding recedes by 1/3rd, loans swell for farm households, finds NABARD survey

Sub : Eco

Sec: Agri

Context:

- The latest *All India Rural Financial Inclusion Survey (NAFIS) 2021-22* by the **National Bank for Agriculture and Rural Development (NABARD)** highlights key trends among **rural farming families** in India.
- This is **NABARD's second survey** conducted since **2016-17**.

Key findings:

- **Rising Income but Increasing Expenses**:
    - The **monthly household income** of farmers **increased** from **Rs 8,059** in **2016-17** to **Rs 12,698** in **2021-22,** a **57.6%** rise.
    - However, **monthly expenditures** also **surged** from **Rs 6,646** to **Rs 11,262**, a **69.4%** increase, showing that while income is rising, so are living costs.
- **Shrinking Landholdings**:
    - Average **landholding size** among farmers **decreased** from **1.08 hectares** in **2016-17** to **0.74 hectares** in **2021-22**, a **31%** reduction.
- **Shift in Spending Patterns**:
    - The share of **food** in total spending **decreased** from **51%** to **47%,** indicating that more is being spent on **non-food items,** raising concerns about food security.
- **Growing Debt Burden**:
    - The percentage of families with outstanding debts rose from **47.4%** in **2016-17** to **52%** in **2021-22.**
    - Despite the **increase** in **debt,** access to formal financial institutions improved, with **institutional lending rising** from **60.5%** to **75.5%.**
- **Access to Government Schemes**:
    - The **Kisan Credit Card (KCC) scheme** expanded from **10.5%** to **44.1%** coverage.
    - **Pension coverage improved,** with **23.5%** of families having at least one member receiving a pension, up from **18.9%.**
    - **Insurance coverage** saw a significant **rise** from **25.5%** to **80.3%.**
- **Improved Financial Literacy:**
    - **Financial literacy** grew from **33.9%** to **51.3%**, and **better money management behaviours** were observed in **72.8%** of families, up from **56.4%**.
    - **More rural families** reported saving money, with **66%** having savings in **2021-22** compared to **50.6%** in **2016-17,** and the average savings amount increased from **Rs 9,104** to **Rs 13,209.**

What is the livestock census? Why is it conducted?

Sub : Eco

Sec : Agri

Context:

- The **21st Livestock Census** was launched by Ministry of Fisheries, Animal Husbandry and Dairying. The enumeration process for the 21st census will take place between **October 2024 to February 2025**.

About Livestock Census:

- Conducted **every five years**, this census is a nationwide **headcount of domesticated animals, poultry, and stray animals** in India.
- The census takes into account information about the **species, breed, age, sex, and ownership status** of the animals.
- Since 1919, a total of 20 livestock censuses have been carried out so far, with the last being conducted in 2019.

Which animals will be counted in the 21st census:

- Information on **sixteen animal species** will be collected in the 21st census.
- These include: **cattle, buffalo, mithun, yak, sheep, goat, pig, camel, horse, ponies, mule, donkey, dog, rabbit, and elephant**.
- In total, the census will capture information on **219 indigenous breeds** of these sixteen species recognised by **ICAR-National Bureau of Animal Genetic Resources (NBAGR).**
- The census will also carry out a headcount of **poultry birds such as fowl, chicken, duck, turkey, geese, quail, ostrich, and emu.**

Objective of the livestock census:

- The livestock sector is crucial for rural employment and contributes approximately **7% to the overall Gross Value Added (GVA)** of the economy and **30% of agricultural GVA.**
- The collected data will assist in **shaping policies** to ensure sustainable growth within the livestock sector.
- The census data will also help **track progress towards achieving UN SDGs**, particularly related to food security and genetic diversity.

How is this census different from previous ones:

- As in 2019, this census will be **fully digitized**, utilizing a mobile application for online data collection and monitoring through a digital dashboard.
- **New Data Points:** This census will collect data on:
- The census will, for the first time, collect data on the **contribution of pastoralists** to the livestock sector, their socio-economic status, and livestock holding.
- The census will find out the **proportion of households whose major income comes from the livestock sector**.

2019 Livestock census:

- The total livestock population recorded then was **78 million**, including 192.9 million cattle, 148.88 million goats, 109.85 million buffaloes, 74.26 million sheep and 9.06 million pigs.
- **All other animals** taken together contributed just **23% of the total livestock population** in India.

SEBI Tightens Noose on Insider Trading

Sub : Eco

Sec: Capital Market

In a bid to strengthen regulations and curb insider trading, **SEBI (Securities and Exchange Board of India)** has introduced significant amendments.

- **Expansion of the Definition of "Connected Persons":**
  - SEBI has **expanded the definition of "connected persons"** to include entities and individuals with potential access to **unpublished price-sensitive information (UPSI)**.
- **New inclusions** under "connected persons":
  - **A firm** or its partner or employee in which a **"connected person"** is also a partner.
  - **A person sharing household or residence** with a **"connected person"**.
- **Amendments to Prohibition of Insider Trading (PIT) Regulations, 2015**:
  - SEBI has made significant updates to the **PIT Regulations** to ensure that more people potentially exposed to price-sensitive information are covered under the regulations.
  - The term **"immediate relative"** has been **replaced by "relative"**, expanding the scope of individuals affected by the regulation.
- **Expanded Definition of Relatives**:
  - As per the new norms, the definition of **"relative"** includes:
    - **Spouse**, parents, and in-laws.

- **Siblings** of both the person and their spouse, and their respective spouses.
- **Children** of the person and their spouse, and their spouses.

- o **Improved Investigation and Enforcement**:
  - These changes are designed to include **persons who have access to unpublished price-sensitive information (UPSI)** but were not previously categorized as **"connected persons"** or **"immediate relatives"**.
  - The broader definition will enable **more effective investigation and enforcement** of insider trading violations.
  - These amendments aim to tighten control over individuals with access to UPSI, thus facilitating **better regulatory oversight** and ensuring **stronger enforcement** actions against insider trading violations.

SEBI (Prohibition of Insider Trading) Regulations, 2015

The **SEBI (Prohibition of Insider Trading) Regulations, 2015** were established by the Securities and Exchange Board of India (SEBI) to **prevent insider trading in securities markets and ensure transparency and fairness in the trading process.**

Key Provisions of SEBI (Prohibition of Insider Trading) Regulations, 2015

- **Definition of Insider**:
  - o An **insider** is defined as a person **who is or was connected with the company or has access to unpublished price-sensitive information (UPSI)** about the company.
- **Prohibition of Insider Trading**:
  - o No insider shall trade in securities of a company when in possession of UPSI.
  - o Trading based on the information that is not generally available is strictly prohibited.
- **Unpublished Price-Sensitive Information (UPSI)**:
  - o UPSI is information related to a company **that is not public and could materially affect the price of its securities.**
  - o Examples include financial results, mergers and acquisitions, changes in the board of directors, etc.
- **Communication of UPSI**:
  - o **Insiders are prohibited from communicating or procuring UPSI to/from others**, except in the ordinary course of business or under a legal obligation.

Painful Choices Loom After China's 'Monumental' Stimulus

Sub: Eco

Sec: Fiscal Market

China's recent **stimulus plan** to shift towards **consumer-driven growth** marks a significant break from its traditional economic policies.

- **Focus on Stimulating Household Demand**:
  - o Beijing plans to issue **sovereign bonds worth about 2 trillion yuan ($284 billion)** in 2024 to **subsidize consumer goods purchases** and **child support**, effectively transferring funds to households.
  - o This marks a **shift towards stimulating consumption**, a move economist has been advocating for over a decade.
- **China's Long-standing Growth Model**:
  - o Since the **1980s**, China has relied heavily on **investment in property, infrastructure, and industry**, often **at the expense of consumer demand**.
  - o Economists argue that this model has led to **overcapacity** in sectors like infrastructure and manufacturing, and **unsustainable debt** since the global financial crisis.
- **Economic Challenges and Potential Growth**:
  - o The current **consumer-focused stimulus** is expected to **help China meet its 2024 growth target of 5%**, despite recent **below-forecast data**.
  - o However, China's **household spending** remains **less than 40% of annual economic output**, **20 percentage points below the global average**, while **investment** stands **20 points above**. Bridging this gap will be a **long-term challenge**.
- **Comparative Insights**:
  - o Historical data shows that it took **Japan 17 years** to increase its consumption share by **10 percentage points** from its low point in 1991.
  - o Analysts warn that China may face a **prolonged period of low growth**, similar to Japan's experience in the 1990s.

- **Structural Issues Hampering Consumption**:
  - China's **socioeconomic structure** has historically favored **investment over consumption**:
    - **Low deposit rates**, **weak labour rights**, and **frail social safety nets** have kept household incomes low.
    - The **tax system** encourages **high investment** with **low wages**.
    - **Capital gains tax** is **20%**, compared to **30% in India** and **37% in the U.S.**
    - The **upper personal income tax rate** in China is among the world's highest at **45%**.
    - **Strategic industries**, like **electric vehicles**, **green energy**, and **robotics**, are frequently supported by **tax exemptions** and **government incentives**, reinforcing the focus on **investment** over consumption.
- **Policy Rebalancing Challenges**:
  - Rebalancing the economy towards **consumer-driven growth** will require a **coordinated, long-term effort** involving various policy changes.
  - Analysts argue that halting **subsidies to manufacturing** and shifting focus to households could lead to a **recession** due to reduced investment in the manufacturing sector.
- **Likely Economic Outcome**:
  - Experts predict that China may choose a **protracted period of rebalancing**, leading to a scenario similar to **Japan's "lost decade"** or **"Japanification"**, with **sluggish growth** but gradual adjustment.
  - To support the **current stimulus**, Beijing is expected to **issue more debt** rather than significantly alter the **income distribution mechanisms** between **businesses, government, and households**.

In conclusion, China's transition from an **investment-driven economy** to one focused on **household consumption** presents **monumental challenges**. While this strategy aims to spur growth in the short term, the **long-term structural changes** required for a sustainable shift will involve **painful choices** and **years of rebalancing**.

Japanification

It refers to the economic phenomenon that mirrors Japan's prolonged period of stagnation and low growth following the asset bubble collapse in the early 1990s.

This term describes various characteristics and consequences **observed in Japan's economy over the last few decades, which some analysts warn could befall other economies, particularly those facing similar structural challenges**.

Key Characteristics of Japanification

- **Prolonged Economic Stagnation**:
  - A sustained period of **low or negative economic growth**, often accompanied by persistent deflation.
- **Low Interest Rates**:
  - Central banks maintain **ultra-low or negative interest rates in an effort to stimulate growth**, which can lead to diminished effectiveness of monetary policy.
- **Deflationary Pressures**:
  - Falling prices can create a cycle of **reduced consumer spending** as people wait for prices to drop further, exacerbating economic stagnation.
- **Aging Population**:
  - A **demographic shift towards an older population**, resulting in lower workforce participation and increased social security and healthcare costs.
- **High Public Debt**:
  - Rising government debt levels, often as a **result of stimulus measures aimed at reviving the economy.**
- **Corporate Sector Weakness**:
  - Companies may become complacent, leading to inefficiencies and a lack of innovation, often referred to as "**zombie companies**" that rely on low borrowing costs to survive.
- **Low Productivity Growth**:
  - Stagnant or declining productivity levels, which can hinder economic growth potential.

India's Regulatory Reforms to Accelerate Homecoming of IPO-Bound Startups
Sub: Eco

Sec: Capital Market

- **Streamlined Reverse Flip Merger Process**:
  - **Reserve Bank of India (RBI)** has **scrapped a time-consuming compliance step** for foreign-based companies performing a **"reverse flip" merger** with a domestic subsidiary.

- o The process time has been **reduced from 12-18 months to approximately 3-4 months**, enhancing efficiency and encouraging startups to list in India.
- **Impact on Indian Startups**:
  - o **Dozens of Indian startups** previously based abroad for better access to capital and favorable tax conditions are now **queuing to return home**.
  - o **Financial hubs** such as the **United States** and **Singapore** are witnessing a **shift** as startups prefer **India's listing prospects** over maintaining dual listings, which are not permitted in India.
- **Notable Startups in Advanced Stages**:
  - o **Razorpay**, **Pine Labs**, and **KreditBee** are in **advanced stages** of completing the reverse flip merger.
  - o **Zepto**, **Eruditus**, and **InMobi** are also preparing to finish the merger process in the coming months to pursue eventual **IPOs**.
- **Advantages of Listing in India**:
  - o **Experts** stated, "**India is a home market** and a place where everybody knows and understands us. From a listing perspective, it makes sense to be in India."
  - o **IPO Prospects**: Listing in India offers investors a **potentially more lucrative exit avenue** and aligns with the **strong appetite for tech stocks** among **Indian public and retail investors**.
- **Regulatory Support and Compliance**:
  - o **Experts** highlighted that the **streamlined merger process** facilitates **swift and efficient scheme approvals** without court intervention.
  - o **Previous Challenges**: Before the regulatory change, companies like **PhonePe** and **Groww** faced lengthy and costly reverse flip processes, with **PhonePe** paying **$1 billion** in capital gains taxes and **Groww** taking several years to complete the merger.
- **IPO Market Growth in India**:
  - o **IPOs by Startups**: In the first nine months of this year, IPOs by startups such as **Ola Electric** and **FirstCry** have raised **$9.17 billion**, up from **$4.68 billion** in the same period last year (**LSEG data**).
  - o This surge positions India as a **rare bright spot** for **equity capital raising** in the **Asia-Pacific region**.
- **Government and Regulatory Stance**:
  - o **Commerce Minister Piyush Goyal** mentioned that startups shifting back to India will have to **pay capital gains taxes**, emphasizing that the motive is **financial gain** through higher **valuations** in India.
  - o **Regulatory Preference**: India's **central bank and other regulators** prefer local firms over foreign counterparts for key operational licenses, enhancing the attractiveness of staying within India's regulatory framework.
- **Future Outlook and Opportunities**:
  - o **Experts also** noted that the regulatory changes will **encourage even more companies** to undertake reverse flips, further boosting the **IPO ecosystem** in India.
  - o **Investment Opportunities**: With easier access to the IPO market, startups can leverage India's growing economic landscape to achieve better growth and valuation outcomes.

Reverse Flipping

Reverse Flipping refers to **overseas start-ups relocating their domicile to India** and opting to list on Indian stock exchanges. This trend is driven by various **economic, market, and policy-based incentives**.

- **Key aspects**:
  - o **Higher Valuation Potential**: Start-ups perceive **India's large and growing economy** as offering opportunities for higher **exit valuations**.
  - o **Access to Venture Capital**: India has **deeper pools of venture capital**, helping businesses secure the funding needed for expansion.
  - o **Favorable Tax Regimes**: Policies provide **tax benefits** that make it lucrative for companies to establish their base in India.
  - o **Improved Intellectual Property Protection**: India now offers **better protection for intellectual property rights**, making it safer to innovate.
  - o **Young and Educated Population**: India's **demographic advantage** adds to the country's attractiveness for entrepreneurship.
  - o **Government Policies**: Initiatives like **Start-Up India** and **Make in India** provide favorable support systems for foreign start-ups.

Govt. recognized reverse flipping as a growing trend and recommended measures to **accelerate the process**.

- **Proposed Simplifications**:

- o **Tax vacations**.
- o **Reforms in Employee Stock Option Plan (ESOP) taxation**.
- o **Easing capital movement**.
- o **Reducing tax layers** to facilitate easier operations.

What is Flipping?

Flipping refers to an Indian company transforming into a **100% subsidiary of a foreign entity**. This involves the **relocation of headquarters overseas** along with the transfer of **intellectual property (IP)** and assets. In this process, the Indian start-up effectively becomes **owned by the foreign entity**, and the founders retain ownership by **swapping shares**.

- **Impact of Flipping on India**:
  - o **Brain Drain**: The relocation leads to the **loss of entrepreneurial talent** from India.
  - o **Loss of Value Creation**: Flipping results in value being created in **foreign jurisdictions** instead of benefiting the Indian economy.
  - o **Intellectual Property and Tax Revenue Loss**: India loses valuable **intellectual property rights** and potential **tax revenues** when companies move overseas.

DIPAM Asks Its Officers Not to Trade in Shares of State-Owned Companies

Sub : Eco

Sec: Capital market

Background:

- The **Department of Investment and Public Asset Management (DIPAM)**, which is under the **Ministry of Finance**, has directed its officials to **refrain from trading shares** of **public sector companies** to **prevent misuse** of **market-sensitive information**.
- DIPAM handles **government equity** in public sector enterprises and is responsible for **minority stake sales, strategic disinvestment, and privatisation** of these companies.

Key Directives:

- **Internal Order to Prevent Trading:**
  - o DIPAM issued an **internal order** stating that officials must **not buy or sell shares** of **state-owned companies**.
  - o **Reason:** Officers might have access to **market-sensitive information** that could influence the **share prices** of companies, and trading could lead to **insider benefits**.
- **Declaration of Holdings:**
  - o **New officers** joining the department are required to **declare their holdings** in **public sector enterprises (PSEs)**.
  - o Any such shares **held by officials** can only be **liquidated after approval** from the authorities, ensuring **transparency and fairness**.

Role of DIPAM:

- **Maximising CPSE Share Value:**
  - o DIPAM's primary goal is to **maximize the value of Central Public Sector Enterprises (CPSE) shares** while ensuring that **no misuse** of **price-sensitive information** occurs.
- **Government Equity Sale:**
  - o The department manages the sale of **central government equity** through various means, such as **offer for sale, private placement, and strategic disinvestment**.
  - o DIPAM also advises on the **financial restructuring** of CPSEs to attract investment through **capital markets**.

U.S. Stays India's Top Trading Ally, Export Destination in 2024

Sub : Eco

Sec: External Sector

The U.S. continues to hold its position as India's **top trading partner** in the first seven months of 2024, with **bilateral goods trade** exceeding **$190 billion**.

- **Growth in Indian Exports to the U.S.**:
  - o Indian exports to the U.S. grew by **9.3%**, reaching **$48.2 billion** during the **January-July 2024 period**.
  - o Major export items included **garments and textiles, pharmaceuticals, precious and semi-precious stones, smartphones, and mineral fuels**.
- **Decline in U.S. Exports to India**:

- o India's imports from the U.S. fell by **5%**, from **$25.9 billion to $24.6 billion** during the same period.
- **Long-Term Export Growth**:
    - o From **2018 to 2023**, India's **merchandise exports to the U.S.** saw substantial growth, increasing from **$54.3 billion** to **$83.8 billion**, marking a **54.4% increase**.
    - o **Services exports** to the U.S. also rose by **25.6%**, from **$28.9 billion in 2018** to **$36.3 billion in 2023**.
    - o Combining both **merchandise and services**, India's total exports to the U.S. surged from **$83.2 billion in 2018** to **$120.1 billion in 2023**, reflecting a **44.3% overall increase**.
- **Impact of Generalized System of Preferences (GSP) Withdrawal**:
    - o The **withdrawal of the GSP scheme** by the U.S. in **2019** had **minimal economic impact** on India.
    - o Although **India was the largest user** of the GSP program, accounting for **$5.7 billion in exports**, this figure is considered **negligible** in the context of **India's broader export portfolio**.
- **India's Imports from the U.S. (January-July 2024)**:
    - o Key import items from the U.S. include **mineral fuels, precious and semi-precious stones, mechanical and electrical machinery, aircraft and parts, ships and boats, chemicals, pharmaceuticals, and edible fruits and nuts**.
- **Significance of the U.S. Market for India**:
    - o The U.S. remains a significant market for **Indian goods**, particularly in **technology and engineering products**.
    - o India's rising demand for **advanced technology, energy, and capital goods** from the U.S. presents opportunities to further **boost bilateral trade**.

In summary, the U.S. continues to be India's most important trading partner, with robust growth in Indian exports. The evolving trade relationship highlights opportunities in **technology, engineering, and advanced capital goods**. Despite the **GSP withdrawal**, the broader trade dynamics remain strong.

Generalized System of Preferences (GSP)

- **Introduction**:
    - o Instituted in **1971** under the **United Nations Conference on Trade and Development (UNCTAD)**.
    - o A **voluntary trade measure** implemented by developed countries to provide **preferential tariff treatment** to imports from developing countries.
- **Key Features**:
    - o **Preferential Tariffs**:
        - ▪ Includes either **elimination** or **reduction** in customs duty for eligible products exported from **beneficiary developing countries (BDCs)**.
    - o **Rules of Origin**:
        - ▪ Exporters must fulfill **rules of origin** criteria to ensure the product originates from the country of export and is not diverted from another country.
    - o **Unilateral Scheme**:
        - ▪ It is a **unilateral customs duty preference scheme**, meaning no reciprocal customs duty preferences are required from India or other BDCs for the developed country.
    - o **Countries Granting GSP**:
        - ▪ Major countries providing GSP preferences include **Armenia, Australia, Azerbaijan, Belarus, Canada, EU, Japan, Kazakhstan, Kyrgyz Republic, New Zealand, Norway, Russian Federation, Switzerland, Tajikistan, Turkmenistan, Turkey, UK, US**, and **Uzbekistan**.
        - ▪ Each developed country has its own **regulatory framework** for GSP tariff preferences.
    - o **Importance of GSP Schemes**:
        - ▪ Varies in terms of product preferences and the exports from developing countries eligible for tariff preferences.
        - ▪ GSPs from the **EU** and **US** are particularly comprehensive and important for developing countries.
        - ▪ Some schemes offer additional tariff preferences to a specified class of developing countries, notably providing extensive coverage to **Least Developed Countries (LDCs)**.
    - o **India's GSP Benefits**:
        - ▪ India is a major beneficiary, realizing significant export volume under the GSP.
        - ▪ Approximately **40%** of India's exports to the **EU** are under the EU GSP.
        - ▪ Prior to the withdrawal of the **US GSP**, around **10%** of India's total exports to the **US** were under this program.

United Nations Conference on Trade and Development (UNCTAD)

- **Overview**:
  - UNCTAD is the **UN's leading institution** dealing with trade and development.
  - Established in **1964** by the **United Nations General Assembly**.
- **Objectives**:
  - Assist developing countries, particularly the **least developed countries** and countries with economies in transition, to integrate beneficially into the **global economy**.
  - Promote a global partnership for development and enhance coherence in **global economic policy making**.
  - Ensure development gains from trade are realized by all.

Malaysia Respects India's Decision on Edible Oil Import Duty Increase

Sub :Eco

Sec: External sector

- **Respect for India's Decision**:
  - **Malaysia's Minister for Plantation and Commodities** stated that Malaysia **respects India's decision** to raise import duties on edible oil.
  - The decision would not affect the **trade relations** between Malaysia and India.
- **Support for India's Sustainable Palm Oil Mission**:
  - Malaysia is ready to support **India's National Mission on sustainable oil palm cultivation** by offering **technology transfer**, **high-yielding seeds**, and **saplings**.
  - Mr. Ghani expressed this support while addressing reporters during the **Malaysian Palm Oil Conference**, an annual event for stakeholders in the palm oil sector.
- **Meeting with Indian Government Officials**:
  - Recently, Mr. Ghani met with **Union Agriculture Minister Shivraj Singh Chouhan** and other senior officials in New Delhi.
  - During the meeting, Malaysia conveyed its **willingness to assist India** with improved **farming practices** and **technology**.
- **Temporary Impact of Import Duty Hike**:
  - Mr. Ghani acknowledged that the **cancellation of some orders** due to the rise in import tariffs on edible oil is a **temporary issue**.
  - He emphasized that **India, with its 1.4 billion population**, will continue to need edible oil, and Malaysia will remain a **trusted partner**, offering **sustainable products**.
- **No Request to Reconsider Tariff Hike**:
  - Malaysia will **not request India** to reconsider the tariff increase, as Mr. Ghani stated it is **India's exclusive right** to make such decisions.
  - He reiterated that **Malaysia values its partnership with India**, which also supplies Malaysia with essential commodities like **rice** and **onions**.
- **Support for Indigenous Palm Oil Production in India**:
  - Malaysia expressed its readiness to **support India's indigenous palm oil production** efforts, ensuring a **strong bilateral relationship** in the agricultural sector.
- **European Union Deforestation Regulation (EUDR)**:
  - On the **EUDR**, which presents challenges to Malaysia as one of the largest exporters of palm oil, Mr. Ghani welcomed the **European Commission's decision to delay its implementation** until **December 30, 2025**.
  - He urged the EU to develop **transparent benchmarking criteria** to avoid unfairly labeling **producer countries** as high-risk, and he hoped for a **more accommodative stance** from the **EU Parliament** to ensure trade fairness.

In summary, **Malaysia remains a supportive partner to India**, focusing on technology collaboration in palm oil production, while continuing to respect India's economic decisions on import duties.

European Union Deforestation Regulation (EUDR)

The EUDR aims to **remove deforestation from the supply chains of everyday items** in the EU. This regulation seeks to ensure that **products imported into the EU do not contribute to deforestation, promoting sustainable land use** and environmental protection.

Legislation

- **Adoption:** The legislation was adopted in Brussels in 2023.

- **Target Year:** The target year for full compliance is 2030.
- **Focus Areas:** Biofuels, palm oil, and deforestation are key areas under the Palm Oil Policy and Deforestation Legislation.

Key Requirements
- **Deforestation-Free Products:** Firms must ensure that products exported to the EU have been grown on land that has not been deforested after December 31, 2020.
- **Due Diligence and Traceability:** The regulation imposes strict due diligence and traceability requirements for commodities such as coffee, cocoa, soy, palm oil, rubber, wood, and cattle.
- **Administrative Burdens:** Palm oil exporters, in particular, face significant administrative burdens to meet the EUDR requirements.

Compatibility and Impact
- **WTO Compatibility:** The EUDR is not compatible with World Trade Organization (WTO) rules and is considered a non-tariff barrier.
- **Impact on Exporters:** Exporters, particularly from developing countries, face increased administrative and compliance costs to meet the stringent requirements of the EUDR.

National Mission for Edible Oils - Oil Palm (NMEO-OP):

The **National Mission for Edible Oils - Oil Palm (NMEO-OP)** was launched by the Government of India in **August 2021**. It is designed to boost **oil palm cultivation** and increase the production of **crude palm oil** (CPO) within the country. The mission aims to make India more self-reliant in the production of edible oils and reduce its dependency on imports.

Key Features:
- **Centrally Sponsored Scheme**:
  - The scheme has a **special focus on the North East region and the Andaman and Nicobar Islands**, as these areas are deemed suitable for oil palm cultivation.
  - It aims to enhance the area and productivity of oilseeds, particularly oil palm.
- **Financial Outlay**:
  - The total outlay for the scheme is **₹11,040 crores**.
  - Of this, **₹8,844 crore** is the **Government of India's share**, and **₹2,196 crore** comes from the **States' share**, including **viability gap funding**.
- **Targets**:
  - **Area Expansion**: Increase oil palm cultivation area to **10 lakh hectares** (from 3.5 lakh hectares in 2019-20) by **2025-26**, adding an extra **6.5 lakh hectares**.
  - **Crude Palm Oil (CPO) Production**: Increase production from **0.27 lakh tonnes (2019-20)** to **11.20 lakh tonnes by 2025-26**.
  - **Consumption**: The mission also aims to maintain **per capita consumption** of edible oil at **19 kg/person/year** until 2025-26 through awareness programs.
- **Implementing Stakeholders**:
  - The scheme will involve a range of stakeholders including the **State Department of Agriculture**, **State Department of Horticulture**, **Central Universities**, **ICAR-Institutions**, **KVKs**, oil palm processors, cooperatives, and media channels such as **DD Kisan** and **All India Radio (AIR)**.

Benefits and Focus Areas:
- The scheme is expected to significantly **reduce India's dependence on imported edible oils, particularly palm oil,** which is a major component of edible oil consumption in the country.
- By focusing on domestic cultivation, especially in regions like the **North East** and **Andaman & Nicobar Islands**, it is aligned with the government's broader goals of agricultural development and self-reliance.

Rupee Hits Record Low of 84 Against USD: Factors Leading to the Fall and the Outlook

Sub :Eco

Sec: External sector
- **Rupee's Record Low**:
  - The **Indian Rupee** ended **above 84 per US dollar** for the first time on **Friday**, closing at **₹84.07**.
- **Factors Triggering the Slide**:
  - **Outflows from Foreign Institutional Investors (FIIs)**:
    - Significant **foreign fund outflows** have exerted downward pressure on the Rupee.

- o **Surge in Crude Oil Prices**:
    - ▪ Rising **crude oil prices** have increased import bills, weakening the Rupee.
- **Higher Demand for the US Dollar**:
    - o Increased demand for the **US dollar** from **foreign banks** has contributed to the Rupee's decline.
- **Weak Domestic Markets**:
    - o **Weakness in domestic equity markets** has further weighed on the Rupee.
- **FII Strategy Shift**:
    - o **Foreign Portfolio Investors (FPIs)** are adopting a **'Sell India, Buy China'** strategy, moving investments to Chinese stocks.
- **RBI's Intervention**:
    - o The **Reserve Bank of India (RBI)** has been actively **protecting the Rupee** level for the **past two months**.
    - o Despite RBI's efforts, the Rupee has **not fallen below ₹84**.
    - o **Softening of the US Dollar Index** helped prevent a sharper decline in the Rupee.
- **US Economic Indicators**:
    - o **Higher than Expected Unemployment Claims**:
        - ▪ US unemployment claims exceeded expectations, signaling potential economic slowdown.
- **Rising US Inflation**:
    - o **US inflation** rose by **0.2% month-on-month** versus a forecasted **0.1%**.
    - o **Core CPI** increased by **0.3%** against a forecast of **0.2%**.
    - o **Annual inflation** also rose more than forecasted.
- **Impact of Domestic Equity Markets**:
    - o **Recovery in Domestic Equity Markets**:
        - ▪ A **recovery in domestic equity markets** has provided some **support to the Rupee**.
    - o **Aggressive Selling by Foreign Investors**:
        - ▪ **Foreign investors' aggressive selling** in domestic markets has restricted the Rupee's gains.
    - o **Foreign Investors Selling Pressure**:
    - o **Strategy Shift to China**:
    - o **FPIs** are **moving investments to Chinese stocks**, perceiving them as **cheap**.
- **Outlook on the Rupee**:
    - o **Volatility Expected**:
    - o The Rupee is expected to remain **volatile** due to:
        - ▪ **Uncertainty over crude oil prices**.
        - ▪ **Fluctuations in the US dollar index**.
        - ▪ **Geopolitical tensions**, especially in the **Middle East**.
    - o **Potential Further Pressure**:
    - o **Overall strength of the US Dollar** may **further pressure the Rupee**.
- **Support from Declining Oil Prices**:
    - o A **decline in crude oil prices** could **support the Rupee** at lower levels.
- **Analyst Insights**:
- **Experts** stated that the Rupee's fall is due to **FII outflows**, **elevated crude oil prices**, and **weak domestic markets**. The **US Dollar Index's overnight softening** prevented a sharper decline and FPIs are **moving money to Chinese stocks**, leading to increased selling pressure on the Rupee.

US Dollar Index (DXY)

- **Definition**:
    - o The **US Dollar Index (DXY)** is a **measure of the value of the US dollar** relative to a basket of six major world currencies.
    - o It provides an overall **indication of the strength or weakness of the US dollar** in the global market.
- **Composition of the Index**:
    - o The index is a weighted average of the US dollar's exchange rates against six major currencies:
- **Euro (EUR)** - approximately **57.6%** (largest component)

- **Japanese Yen (JPY)** - around **13.6%**
- **British Pound (GBP)** - about **11.9%**
- **Canadian Dollar (CAD)** - approximately **9.1%**
- **Swedish Krona (SEK)** - about **4.2%**
- **Swiss Franc (CHF)** - around **3.6%**
- **Important**: The **Euro** has the largest weight, making movements in EUR/USD the most influential in the index.
- **Historical Background**:
  - The **US Dollar Index** was introduced in **1973** by the **Intercontinental Exchange (ICE)**.
  - It was initially set to a **base value of 100**, reflecting the value of the dollar after the **Bretton Woods Agreement** was terminated, and currencies began to float freely against each other.
- **Purpose and Use**:
  - The **DXY** serves as a **benchmark** for the performance of the US dollar globally.
  - It is used by **traders, investors, and economists** to gauge the relative strength of the dollar, assisting in decisions related to **foreign exchange (Forex) trading, commodity pricing, and investment strategies**.
- **Example**: If the DXY rises, it indicates the US dollar has appreciated against the basket of currencies, while a decline suggests a depreciation.
- **Implications**:
  - A **strong DXY** generally indicates a robust US dollar, which can lead to:
    - **Higher import purchasing power** for US consumers.
    - **Potentially lower commodity prices** (since commodities are often priced in USD).
    - **Challenges for US exporters**, as a stronger dollar makes US goods more expensive in foreign markets.
    - Conversely, a **weaker DXY** may boost US exports but increase import costs, leading to **inflationary pressures**.

White Goods PLI Scheme: 38 Companies, Including Voltas and Blue Star, Apply in Third Round
Sub : Eco

Sec: External sector
- **Overview**:
  - A total of **38 companies** have applied under the **Production-Linked Incentive (PLI) scheme** for white goods, focusing on **air-conditioners (ACs) and LED lights**.
  - Major companies like **Daikin, Voltas, and Blue Star** are among the applicants, with a **proposed investment of ₹4,121 crore**.
- **Scheme Reopened**:
  - The government **reopened the application window** for the ₹6,238-crore PLI scheme in **July 2024** to accommodate more players due to increased interest from companies.
  - This is the **third round** of applications for the scheme, indicating the growing demand and participation in the initiative.
- **Investment Breakdown**:
  - **21 companies** have applied for the **manufacture of AC components**, committing to an investment of **₹3,679 crore**.
  - **18 applicants** have committed to manufacturing **components for LED lights**, with an investment of **₹442 crore**.
  - The investments aim to boost local production, reduce imports, and enhance the competitiveness of the Indian manufacturing sector.
- **Impact on the Sector**:
  - **Department for Promotion of Industry and Internal Trade (DPIIT)**, stated that the PLI scheme is significantly **benefitting the white goods sector**.
  - The **value addition** in the sector has improved from **25% to about 50%**, showing the positive impact of the scheme on domestic manufacturing.
- **Expected Outcomes**:
  - Over the next **three years**, the **38 companies** are projected to achieve a production value of around **₹55,877 crore** for AC components and LED lights.

- o The initiative is expected to **generate direct employment for 47,851** individuals, contributing to economic growth and job creation.
- **Purpose of the PLI Scheme**:
  - o The **PLI scheme for white goods** aims to **promote local manufacturing** by offering financial incentives based on incremental production.
  - o It encourages **investment in domestic production** of ACs and LED components, aiming to reduce dependency on imports and strengthen the **'Make in India'** initiative.

This initiative is part of India's broader strategy to **boost local manufacturing**, reduce import dependence, and promote self-reliance in critical sectors.

Production Linked Incentive (PLI) Scheme

- **Introduction**:
  - o The **Production Linked Incentive (PLI) Scheme** is an initiative by the **Government of India** aimed at promoting **domestic manufacturing** and reducing dependency on imports.
  - o It provides **financial incentives** to companies on their **incremental sales** of products manufactured in India, thus encouraging them to set up or expand production facilities.
- **Objectives**:
  - o **Boost Manufacturing**: The scheme aims to enhance **domestic production capacity** across various key sectors.
  - o **Reduce Imports**: By encouraging local manufacturing, the scheme seeks to reduce **dependency on imports**, thereby improving the trade balance.
  - o **Employment Generation**: Increased production capacity is expected to **create more job opportunities**, benefiting the Indian economy.
  - o **Economic Growth**: Enhanced manufacturing output can contribute to **overall economic growth**, with an estimated impact over the next five years.
- **Incentive Structure**:
  - o Companies are rewarded based on their **performance** and the **incremental sales** of domestically manufactured goods.
  - o The scheme is **sector-specific**, with each sector having its own set of **eligibility criteria** and incentive structures.

Important: The schemes are being implemented in various stages by the respective **Ministries/ Departments**.

India Faces Container Shortage Hindering Trade Growth: Key Factors and Government Initiatives
Sub: Eco

Sec: External Sector

- **Overview of Container Shortage**:
  - o **India's Rapid Trade Growth** relies heavily on **containerized transport**.
  - o A significant **logistical bottleneck** exists due to the **insufficient production of containers** in India.
- **Importance of Containers in Trade**:
  - o **Seamless Transportation**: Containers can be transported via **rail, ship, and road** without disturbance.
  - o **Efficiency**: Standardized dimensions and cargo capacities **reduced transportation time** and **port delays**, revolutionizing global trade.
  - o **Globalization**: Containerization is crucial for **swift trade movements**, enabling the seamless flow of goods internationally.
- **Current Scenario in India**:
- **Container Handling Capacity**:
  - o **India's container market** is expected to **more than double** from **11.4 million TEU** (twenty-foot equivalent units) in **2023** to **26.6 million TEU by 2028**.
  - o **Manufacturing Output**: India produces **10,000 to 30,000 containers annually**, which is only a **fraction of the projected demand**.
- **Comparison with China**:
  - o **China** manufactures **2.5 to 3 million containers** per year.
  - o **Cost of Production**: In India, it costs **₹3,500 to ₹4,800** to produce one container, compared to **₹2,500 to ₹3,500** in China.
  - o **Leasing Dependency**: Due to low domestic production, India **leases containers mostly from China**.

- **Impact of Container Shortage**:
  - **Freight Rates**: Shortage often leads to **increased freight rates**.
  - **Port Congestion**: Limited containers cause **congestion at Indian ports**, preventing them from becoming **hub ports**.
- **Shift of Mother Ship Traffic**:
  - **Colombo, Dubai, and Hong Kong** attract **mother ship traffic** instead of Indian ports.
  - **Short Distance Feeder Vessels**: Indian shippers rely on **short distance feeder vessels**, leading to **higher tariffs**.
- **Global Disruptions**:
  - **West Asia Crisis**: Disruptions like the **Russia-Ukraine war** have led to **port closures**, **route changes**, and **increased insurance costs**, further **raising freight rates**.
  - **Piracy**: Increased piracy has also **elevated freight costs**.
  - **Longer Voyages**: Circumnavigating Africa lengthens voyages by **10 to 15 days**, affecting container availability.
- **Government Initiatives to Address Shortage**:
- **Make in India Initiatives**:
  - **Promote Indigenous Production**: Encouraging domestic production of container boxes through **Public-Private Partnerships (PPP)** between the **Container Corporation of India** and private players.
  - **Incentives**: Providing **direct subsidies** and **viability gap funding** to support private production.
  - **Production Linked Incentives (PLI)**: Implementation of **PLI schemes** to boost container manufacturing.
- **Additional Measures**:
  - **Reduce Charges**: Lowering **repositioning and storing charges** for empty containers to ease shortages.
  - **Enhance Container Yard Capacities**: Expanding **container yard capacities** at Indian ports to accommodate more containers.
  - **Cost Reduction**: Ensuring that **scaled-up production costs** align with **global levels**.
  - **GST Relaxation**: **Relaxation of GST** for manufacturers of raw materials needed for container production to **reduce input costs**.
  - **Support for Shippers**: Incentivizing Indian shippers to **use Indian-made containers** and facilitating **long-term contracts** with domestic manufacturers to build **market confidence**.
  - **Mandate Usage**: **Mandating the use** of **Indian-made containers** to **boost domestic demand**.
  - **Tracking and Tracing**: Developing a **Unified Logistics Interface Platform** and **Logistics Data Bank** to **track and trace containers**, reducing turnaround time and easing shortages.
- **Expected Outcomes**:
  - **Increased Production**: Boosting container manufacturing to meet the **projected demand**.
  - **Economic Growth**: Facilitating **swift transport of goods**, thereby **supporting trade growth** and **economic expansion**.
  - **Employment Generation**: Creating **direct employment opportunities** in the manufacturing and logistics sectors.
  - **Global Competitiveness**: Enhancing India's position as a **competitive hub** in the **East-West trade route**.
- **Expert Insights**:
  - Experts emphasizes that there is a **critical need for container production** to support India's trade ambitions.
  - **Strategic Location**: Despite being at a **strategic location**, the **container shortage** hampers Indian ports from attracting **mother ship traffic**.

Global Public Debt Expected to Reach $100 Trillion: IMF Report
Sub : Eco

Sec : External sector

- **Record High Debt Levels**:
  - The **International Monetary Fund (IMF)** has forecasted that **global public debt** will reach an unprecedented **$100 trillion** in 2024.
  - This debt level is expected to be **93% of global GDP** this year, and it may approach **100% of GDP by 2030**. This marks a significant increase of **10 percentage points** compared to pre-pandemic levels in **2019**.
- **Rising Fiscal Pressures**:

- o **Era Dabla-Norris**, the Deputy Director of the IMF's Fiscal Affairs Department, highlighted several factors contributing to the worsening debt outlook:
- o **Increased spending pressures**: Countries are facing higher expenditure to address issues like **climate change** and economic recovery.
- o **Overly optimistic debt projections**: Current estimates might be underestimating the actual future debt levels.
- o **Unidentified debt**: Potential hidden or unaccounted debts could lead to a more severe fiscal scenario than anticipated.
- **Need for Fiscal Adjustment**:
  - o The IMF emphasized that it is **crucial for nations to implement fiscal discipline** to manage their debt levels.
  - o Experts stated, "It's time for countries to get their fiscal house in order."
  - o According to the report, the required fiscal adjustment to bring debt under control would be between **3.0% and 4.5% of GDP** on average, which is almost **double** the size of previous adjustments.
- **Worst-Case Scenario**:
  - o The IMF warned that if current trends continue, **global public debt** could surge to **115% of GDP by 2026**. This would be **20 percentage points** higher than the baseline estimate, reflecting the potential for a more severe global debt crisis.

Global Debt

Debt is the amount of money borrowed by an entity that is expected to be **paid back** at a later time, typically with interest.

Global Debt refers to the **total outstanding amount** owed by **governments, businesses, and individuals** across the world. It encompasses both **public** and **private debt**.

Composition of Global Debt:
- **Public Debt**:
  - o This is the **money owed by governments** to domestic and foreign creditors.
  - o Governments typically finance this debt by issuing **bonds, treasury bills, or loans** from international organizations (e.g., the International Monetary Fund or World Bank).
  - o Public debt includes **national and local government borrowings**, often used for **infrastructure projects, social programs, and budgetary expenses**.
- **Private Debt**:
  - o Refers to the **money owed by businesses and individuals** to financial institutions, including banks, lenders, and other creditors.
- **Types of Private Debt**:
  - o **Corporate Debt**: Loans taken by businesses for expansion, operations, or investments, including **corporate bonds**.
  - o **Household Debt**: Borrowings by individuals, such as **mortgages, student loans, credit card debt**, and personal loans.

UAE to review India's concerns over silver import surge: Centre

Sub : Eco

Sec : External Sector

Context:
- India raised concerns regarding a **significant increase in imports of silver products, platinum alloy, and dry dates from the UAE** during a meeting with officials from the Ministry of Economy of the UAE.
- The United Arab Emirates has agreed to examine the concerns raised by India.

Issues raised:
- The Indian government urged the UAE to ensure compliance with trade regulations under the Free Trade Agreement (FTA) that took effect on May 1, 2022.
- India asked UAE to verify compliance with the **rule-of origin norms** and ensure the rules are not circumvented.

Bilateral Trade:
- The UAE is **India's third-largest trading partner**, with bilateral trade reaching **$83.65 billion** in the fiscal year 2023-24.

Surge in imports:
- **India UAE CEPA** allows **unlimited imports** of gold, silver, platinum and diamonds from the UAE into India.

- The **Global Trade Research Initiative (GTRI)** reported that gold and silver imports from the UAE **increased by 210%,** totalling $10.7 billion in 2023-24.
- The significant rise in imports has led India to call for a review of certain provisions of the FTA.

India-UAE Comprehensive Economic Partnership Agreement (CEPA):
- The Comprehensive Economic Partnership Agreement (CEPA) between India and the UAE aims to enhance bilateral trade and investment.
- A critical component of this agreement is the **Rules of Origin**, which determine the nationality of a product and whether it qualifies for preferential tariff treatment under the CEPA.

Rules of Origin:
Rules of Origin are **criteria used to define the national source of a product**. Goods must meet specified criteria to qualify for reduced tariffs under the CEPA.

They play a crucial role in international trade by:
- Ensuring that the benefits of trade agreements are granted only to goods produced in the partner countries.
- Preventing the **circumvention of trade barriers through third-party countries**.

Tariff Concessions:
- India currently offers a **7% customs duty concession on silver imports and a 1% concession on 160 metric tonnes of gold**.
- The GTRI claimed that many imports **did not meet rules of origin norms** and hence, did not qualify for concessions.

Proposed Designated Zone:
- India has requested that the **Indian Jewellery Exposition Centre in Dubai** be classified as a Designated Zone.
- This designation would allow domestic jewellery manufacturers, including non-registered entities, to benefit from concessional duties under UAE regulations.

Mutual Recognition Agreements:
- India also highlighted the necessity for both countries to establish mutual recognition agreements for professional bodies.
- This would enable professionals such as chartered accountants, lawyers, and nurses to provide services without the need for additional certification.

Focus on Quality; Export Competitiveness Won't Come from Govt Subsidies: Goyal to Industry
Sub : Eco

Sec: External Sector
- **Quality Over Subsidies**:
  - Commerce and Industry Minister Piyush Goyal emphasized that **export competitiveness should not rely on government subsidies**. Instead, it should come from the **industry's focus on high-quality products**.
  - He highlighted that **self-reliance and self-confidence** will be achieved when industries see **quality as a duty, not just a job**.
- **Government's Efforts**:
  - The government is implementing steps like **Quality Control Orders (QCOs)** to boost the manufacturing sector.
  - Initially, there was resistance from the industry, but the government is pushing for the **adoption of quality standards**.
- **Growth in Quality Control Orders (QCOs)**:
  - Till 2014, only **14 QCOs** were issued covering **106 products**.
  - In the last decade, this number increased significantly to **174 QCOs**, now covering **732 products**.
  - These QCOs aim to curb the import of **sub-standard products**, prevent **unfair trade practices**, and ensure **consumer safety**.
- **Strict Compliance**:
  - As per QCOs, products **cannot be produced, sold, or imported** without the **Bureau of Indian Standards (BIS) mark**.
  - Violations can result in **up to two years of imprisonment** or a **fine starting at ₹2 lakh**. Repeat offenses will lead to heavier fines, up to **10 times the value** of the goods.
- **Global Recognition**:
  - The government wants India to be recognized as a **manufacturer of high-quality goods and services** on the global stage.

- o Goyal encouraged **industry players to guide and support MSMEs** in achieving higher quality standards, particularly citing the **pharma sector** as an area needing improvement.
- **Industry Participation**:
  - o Goyal urged industries to **participate in BIS committees** by providing **skilled technical manpower**, ensuring better alignment with quality standards.
  - o He also pointed out that India's efforts to join **global protocols in sectors like pharma** have been hindered by **resistance to adhering to stringent standards**.
- **QCOs and WTO Compliance**:
  - o The issuance of QCOs is in line with the **WTO Agreement on Technical Barriers to Trade**, ensuring that quality standards are met without violating international trade rules.

The emphasis is on **quality assurance, collaboration between large enterprises and MSMEs**, and **strict adherence to standards** to elevate India's **manufacturing capabilities and export competitiveness**.

Factors Affecting Export Competitiveness

- **Cost Competitiveness**:
  - o Production Costs
  - o Wage Levels
  - o Economies of Scale
- **Exchange Rate**:
  - o Currency Value
  - o Exchange Rate Stability
- **Product Quality and Innovation**
  - o Quality Standards
  - o Innovation and Technology
- **Infrastructure**:
  - o Transport and Logistics
  - o Energy Supply
  - o Digital Infrastructure
- **Government Policies**:
  - o Export Incentives
  - o Trade Agreements
  - o Ease of Doing Business
- **Access to Raw Materials**:
  - o Availability of Raw Materials
  - o Diverse Supply Chain
- **Skilled Workforce**:
  - o Technical Skills
  - o Training and Education
- **Market Diversification**:
  - o Geographical Spread
  - o Product Diversification
- **Global Economic Conditions**:
  - o Global Demand
  - o Trade Barriers and Protectionism
- **Branding and Marketing**:
  - o Brand Recognition
  - o Effective Marketing Strategies
- **Environmental and Ethical Practices**:
  - o Sustainability
  - o Ethical Standards

Quality Control Orders (QCOs)

- **Definition**:
  - o **Quality Control Orders (QCOs)** are **regulatory measures** introduced by the government to establish **quality standards** for specific products or product categories.
  - o These orders ensure that products meet certain **prescribed quality, safety, and performance requirements** before they can be **manufactured, imported, stored, or sold** in the country.
- **Objective**:
  - o The primary aim of QCOs is to **control the import of sub-standard and cheaper items** into the domestic market.
  - o It ensures that customers have access to **quality products** that meet the necessary standards, thus enhancing **consumer protection** and **market integrity**.
- **Regulatory Compliance**:
  - o Under the QCOs, **manufacturing, storing, and sale** of products that do not comply with the standards set by QCOs is **prohibited**.
  - o The **Bureau of Indian Standards (BIS)** plays a crucial role in ensuring compliance with the quality standards established under QCOs.
  - o BIS is responsible for **certifying products** that meet these standards for both **domestic and international manufacturers**.
  - o As per the **BIS Act, 2016**, any **non-BIS certified products** are restricted from being sold, ensuring adherence to the quality framework.
- **Legal Framework**:
  - o QCOs cannot be **challenged at the World Trade Organization (WTO)** if they are imposed on grounds related to:
    - ▪ **Health**
    - ▪ **Safety**
    - ▪ **Environmental protection**
    - ▪ **Deceptive trade practices**
    - ▪ **National security**
  - o This provision allows the government to enforce QCOs without violating international trade agreements, given that the regulations align with globally recognized standards for **health and safety**.

Spectrum allocation
Sub: Eco

Sec: External sector

Context: GOI has clarified that spectrum for satellite communication (satcom) would be allocated "administratively", rather than through an auction of airwaves, which was proposed by Reliance Jio earlier this month.

Auction vs allocation

- It is important to understand the key difference between spectrum for terrestrial networks and satellite communication, and why the distinction between allocation and auctioning arises in the first place.
- For terrestrial mobile services, spectrum is exclusive and is managed only by a single mobile operator in a given geographical area; therefore, this cannot be shared between or amongst operators.
- In the case of satellites, the same spectrum is non-exclusive in nature — and can be used by multiple satellite operators to serve the same geographical area.
- The general trend, therefore, is to allocate satellite spectrum administratively.

Why administrative allocation?

- Given the nature of satellite spectrum, it is not feasible for any one country to auction it. Unlike terrestrial spectrum, which is used for mobile communication, satellite spectrum has no national territorial limits. Due to this **international character,** satellite spectrum is coordinated and managed by the **International Telecommunication Union (ITU),** a specialised agency of the United Nations (UN).
- Spectrum for satcom is part of the **first schedule** of The Tele**communications Act, 2023 ("Assignment of spectrum through administrative process").** Under **Section 4(4) of the Act,** telecom spectrum shall be assigned through auction "except for entries listed in the First Schedule for which assignment shall be done by administrative process".
- "Administrative process" under the Act "**means assignment of spectrum without holding an auction", and "'auction' means a bid process for assignment of spectrum".**

Size of satcom sector

- Consulting firm KPMG in India has estimated in a recent report that the country's satcom sector, which currently stands at $2.3 billion a year, will reach $20 billion by 2028.
- India is ranked fourth in terms of investments in the sector globally. Investment bank Morgan Stanley has estimated roughly 290.4 million households in India are untapped with broadband, which present a strong market opportunity for satellite operators.

Satcom & its benefits

- Satcom services use an array of satellites in orbit to provide connectivity on the ground thus they do not require wires to transmit data.
- For end-users such as homes and businesses, satellite-based communication and broadband services offer two key benefits: wider coverage, and a more resilient network. Even though the latency of satcom services can at times be higher than terrestrial broadband networks, they can cover vast areas without needing to install much physical equipment.
- The use of satellites allows communication networks to reach remote locations that mobile telephony cannot access. It is generally understood that when satcom services become more mainstream, low-lying and rural areas, and areas prone to natural disasters, will benefit from constant connectivity.

Emerging Economies Face Liquidity Crisis Amid Debt Challenges

Sub: Eco

Sec: External sector

Background:

- Many **emerging economies** are grappling with a **liquidity shortfall**, with concerns rising that this could significantly impact development, climate change mitigation, and overall stability.

Key Issues:

- **Post-COVID Sovereign Defaults:**
  - Countries like **Ghana, Sri Lanka, and Zambia** have faced significant **debt defaults**, leading to painful debt restructuring.
  - While the wave of defaults has slowed, concerns about **liquidity shortfalls** have grown, potentially affecting **development projects** and undermining trust in governments and Western institutions.
- **Rising Debt Service Costs:**
  - In **2022**, 26 countries, including **Angola, Brazil, Nigeria, and Pakistan**, paid more to **service external debts** than they received in new financing.
  - This trend continued into **2023**, with data indicating a net negative flow of funds for many developing countries, highlighting a crisis where **affordable refinancing** options have become scarce.
- **Global Financial Safety Net Concerns:**
  - According to **experts**, the existing global safety net led by the IMF is not sufficient to handle the current financial distress.
  - Calls for **additional funding and improved liquidity support**, as current measures do not adequately address the growing costs of debt for emerging economies.

Factors Contributing to the Crisis:

- **Western Countries' Hesitation:**
  - Developed nations are showing a **hesitation** to increase their financial support to emerging markets, partly due to **budget constraints** and multiple global crises.
  - This reluctance has been a major discussion point at the IMF-World Bank meetings, as it affects the ability of international bodies to provide sufficient liquidity support to struggling nations.
- **China's Reduced Lending:**
  - **China's pull-back** in lending has significantly affected emerging countries, turning a previously large source of cash into a **net negative flow**.
  - The reduction in Chinese loans has forced countries to seek alternative financing, often at **higher costs**.
- **Rising Interest Rates:**
  - Over the past decade, many countries accessed bond markets, but as **global interest rates have increased**, refinancing has become less affordable.
  - For example, **Kenya** recently borrowed at an interest rate of **over 10%**, a level that is widely considered **unsustainable**.

Current Efforts to Address the Crisis:

- **IMF and World Bank Initiatives:**

- o The **IMF** has cut **surcharges**, reducing the cost for the most stretched borrowers by **$1.2 billion annually**.
- o The **World Bank** aims to increase its lending capacity by **$30 billion over 10 years**.
- **Development Banks' Collaboration:**
    - o Development banks like the **Inter-American Development Bank** and the **African Development Bank** are pushing for the donation of **IMF reserve assets** (Special Drawing Rights) to enhance lending capabilities.

Implications and Risks:

- **Development and Social Spending Cuts:**
    - o Due to increased debt service, many countries are cutting back on **education, health, and infrastructure**, which can have long-term impacts on growth and development.
- **Social Unrest and Political Instability:**
    - o The combination of **economic stress and liquidity issues** is leading to protests and social unrest in several nations, including **Kenya and Nigeria**.
    - o Experts warn that this trend poses a significant risk of **political instability** across the **Global South**, potentially leading to a broader crisis.

Inter-American Development Bank (IDB)

- **Overview**:
    - o The Inter-American Development Bank (IDB) is a **regional development bank established in 1959 to promote economic and social development in Latin America** and the Caribbean.
    - o It is headquartered in **Washington, D.C., USA**, and provides financial and technical assistance to support projects that improve infrastructure, education, healthcare, and other areas critical for development.
- **Membership**:
    - o The IDB has **48 member countries**, including 26 borrowing members from Latin America and the Caribbean. The rest are non-borrowing members, mainly from North America, Europe, and Asia.
- **Key Focus Areas**:
    - o Poverty reduction, sustainable development, infrastructure, regional integration, innovation, and digital transformation.

African Development Bank (AfDB)

- **Overview**:
    - o The African Development Bank (AfDB) is a **multilateral development bank** founded in 1964, with the primary objective of spurring sustainable economic development and social progress in Africa.
    - o It is headquartered in **Abidjan, Côte d'Ivoire**, and operates across the continent.
- **Membership**:
    - o The AfDB consists of **54 African member countries** and **27 non-African member countries**, including nations from Asia, Europe, and North America.
- **Key Focus Areas**:
    - o Priority areas, also known as the **"High 5s"**, include: *Light Up and Power Africa, Feed Africa, Industrialize Africa, Integrate Africa, and Improve the Quality of Life for the People of Africa.*

Challenges in Fertilizer Imports and the Impact of Global Conflicts on India's Fertilizer Market

Sub : Eco

Sec :External sector

Overview of the Fertilizer Sector in India

- **Types of Fertilizers**: The three primary fertilizers in India are **Urea**, **Diammonium Phosphate (DAP)**, and **Muriate of Potash (MOP)**.
- **India's Position in Global Consumption**: India is the **second-largest consumer of fertilizers worldwide**, following **China**.
- **Rising Demand for Urea and DAP**:
    - o **Urea** and **DAP** usage has increased, while demand for other fertilizers has been declining, reflecting a shift in consumption patterns.

Breakdown of Key Fertilizer Types

- **Urea**:
    - o Most Widely Used Fertilizer.

- o Urea is highly subsidized.
- **Production Process**:
  - o Urea is produced from **natural gas**.
  - o **Methane** in natural gas undergoes **steam reforming** to yield **hydrogen**.
  - o Hydrogen is then combined with **nitrogen** to produce **ammonia**, which can either be used as a fertilizer directly or converted to **urea** by reacting with **carbon dioxide**.
- **Diammonium Phosphate (DAP)**:
  - o **Second Most Used Fertilizer** in India, following urea.
  - o Composition: **46% Phosphorus** and **18% Nitrogen**.
  - o **Phosphorus Source**: DAP is the preferred phosphorus-based fertilizer among farmers, just as urea is preferred for nitrogen.
- **Muriate of Potash (MOP)**:
  - o Also known as **potassium chloride**, MOP contains **60% potash**.
  - o **Potash Role**: Essential for **plant growth** and **quality**, potash aids in **protein and sugar production**, vital for overall plant health.

Subsidy Mechanism and Nutrient-Based Subsidy (NBS)

- **Urea Subsidies**: As the most critical fertilizer, urea receives **direct subsidies**, covering a significant portion of its cost.
- **Nutrient-Based Subsidy (NBS)**:
  - o **DAP and MOP** producers and importers benefit from a Nutrient-Based Subsidy.
  - o The NBS formula provides subsidies based on the **ratio of nutrients (N, P, and K)**, maintaining a **4:2:1 balance** to support balanced fertilizer usage.

India's Challenges in Fertilizer Imports

- **High Dependency on Imports**:
  - o India meets **20% of its urea**, **50-60% of DAP**, and **100% of Muriate of Potash (MOP)** demand through imports, creating a **vulnerability to global market fluctuations**.
- **Financial Strain from Subsidies**:
  - o To mitigate high fertilizer costs, the Indian government has allocated **₹1.79 lakh crore in subsidies for 2023-24**.
  - o Subsidy breakdown includes **₹1,04,063.20 crore** for indigenous urea and **₹31,000 crore** for imported urea.

Impact of Global Conflicts on India's Fertilizer Market

- **Rising Prices of Raw Materials**:
  - o The **conflict in Ukraine** has caused a spike in the prices of **oil and petroleum-based raw materials** used in fertilizers, leading to higher production costs globally and impacting Indian imports.
- **Supply Chain Disruptions**:
  - o India's primary fertilizer imports are sourced from regions like **Russia, China, Saudi Arabia, and Egypt**. Disruptions due to the **Ukraine crisis** and **West Asian tensions** affect these supply chains, causing shortages and higher import costs.
- **Impact on Agricultural Production and Food Security**:
  - o Rising prices and supply chain issues pose risks to **India's food security** as fertilizers like **DAP and NPK** are crucial for **winter rabi crops**.
- **Increased Dependence on Government Subsidies**:
  - o With escalating prices, Indian agriculture's reliance on **government subsidies** grows, increasing **fiscal pressure** on the national budget and impacting long-term food security.

Recommendations for India's Fertilizer Sector

- **Innovative Fertilizer Use and Sustainable Practices**:
  - o **Nano-urea**, **natural farming**, and **precision fertilization** techniques can help optimize fertilizer use and reduce import requirements.
  - o Focusing on **self-reliance and sustainable agriculture practices** will help counter long-term risks from global market disruptions.

Roll back nod given to import used medical devices

Sub : Eco

Sec: External Sector

Context:

- Key stakeholders from the Indian med-tech industry, including the Association of Indian Medical Devices, the Manufacturers of Imaging, Therapy and Radiology Devices Association, and the Association of Diagnostic Manufacturers of India, have expressed strong **opposition to the recent policy allowing the import of refurbished and pre-owned medical devices**.

Background:

- Recently office memorandums were issued by the Ministry of Environment, Forest, and Climate Change (MoEFCC), the Directorate General of Health Services (DGHS), and the Ministry of Health & Family Welfare (MoHFW).
- These memorandums permit the import of refurbished and pre-owned medical devices.
- The policy aims to provide **cost-effective medical solutions**, particularly in underserved regions, by facilitating access to refurbished medical equipment.

Concerns raised:

- **Threat to Domestic Manufacturing:** It is argued that importing used medical devices undermines progress in domestic manufacturing and represents a significant setback to India's self-sufficiency in the medical device sector.
- **Patient Safety risks:** The group warns that refurbished medical devices may not meet strict quality standards, raising concerns about patient safety and the reliability of healthcare using these imports.
- **Impact on Innovation and Investment:** Stakeholders contend that allowing refurbished imports undermines India's ability to produce high-quality medical devices, stifles innovation, deters investment, and could hinder the growth of the domestic med-tech industry.

Why is there an Upward Rally in Gold Prices?

Sub : Eco

Sec: External sector

- **Geopolitical Tensions and Economic Uncertainty**:
  - Gold prices surged to an all-time high, due to heightened geopolitical tensions and global economic instability.
  - In India, gold mirrored this trend, marking a **40% increase** from last year's price.
- **Inverse Relationship with Interest Rates**:
  - **Lower interest rates and a weaker U.S. dollar** make gold more attractive, driving up demand as it provides a safety net amidst low yields on other assets.
  - While gold doesn't yield returns, it gains appeal as a store of value when interest rates fall, prompting investors to seek the "safe haven" of gold.
- **Global Demand for Safe-Haven Assets**:
  - Amid global uncertainties, investors are drawn to gold due to its **low correlation with other asset classes** and ability to hedge against inflation and currency fluctuations.

Why is Gold Considered a Safety Cushion by Central Banks?

- **Hedge Against Global Uncertainties**:
  - Central banks accumulate gold to mitigate risks from economic and political crises, benefiting from its **stability and long-term value**.
  - **August Net Purchases**: According to the **World Gold Council (WGC)**, central banks acquired **8 tonnes** of gold in August, with **Poland, Turkey, and India** as major buyers.
- **Diversification of Foreign Exchange Reserves**:
  - Holding gold diversifies central banks' reserves, reducing dependence on volatile currency values and other assets that are more impacted by economic downturns.

When Does Demand for Gold Peak in India?

- **Festive and Wedding Seasons**:
  - **High Demand Period**: Gold demand typically spikes in the **second half of the year**, coinciding with Indian festivals like **Diwali** and the wedding season.
  - **Buffer Period**: The period from **mid-September to early October** is often a lull, as it's considered inauspicious for purchases according to the Hindu calendar.
- **Price Impact**:
  - Gold prices generally increase during these peak periods, reflecting heightened demand and strong cultural significance tied to the yellow metal.

Why Does the World Gold Council Expect Increased Demand for Gold from Rural Areas?

- **Favourable Monsoon and Crop Production**:
  - o Good **monsoon** seasons and **higher crop sowing** are expected to enhance rural incomes, thereby boosting the purchasing power for gold in rural India.
  - o **Rural Spending Power**: Strong harvests and improved incomes can lead to **higher gold consumption**, especially in rural and Tier II and III cities.
- **Impact of Reduced Import Duties**:
  - o The reduction in **gold import duties** in July has already **boosted domestic demand**, making gold more accessible and attractive to Indian buyers.

What Factors Determine Gold Prices?
- **Supply and Demand Dynamics**:
  - o **Finite Resource**: Gold's limited availability adds a scarcity factor to its valuation, with the long **gestation period from mining to production** making it less responsive to short-term market changes.
- **Dollar Value and Interest Rates**:
  - o Gold prices are globally referenced in **U.S. dollars**; hence, a weaker dollar often leads to higher demand for gold as a hedge against currency depreciation.
  - o An **inverse relationship with interest rates** also influences prices; lower rates make non-yielding assets like gold more appealing.
- **Investor Appetite**:
  - o Investor sentiment compared to other assets (such as bonds) plays a role, especially during periods of geopolitical unrest or financial instability, where gold acts as a **store of value**.

Supreme Court Lays Down 'Functionality' and 'Essentiality' Test for Claiming Input Tax Credit (ITC)
Sub: Eco

Sec: Fiscal policy
- **Supreme Court Judgment on ITC for Real Estate Companies**:
  - o Real estate companies can claim **Input Tax Credit (ITC)** under the **Goods and Services Tax (GST)** regime for costs incurred on **construction of commercial structures** intended for **renting or leasing purposes**.
  - o The judgment is a **positive development for the real estate sector**, providing them the benefit of ITC for commercial properties.
- **Conditions for ITC Eligibility**:
  - o A building qualifies for ITC if it is deemed to be a **plant** and is used for the supply of services such as **renting or leasing**.
  - o ITC can be availed only if the other terms and conditions under the **CGST Act and Rules** are fulfilled.
- **Key Clarification by the Court**:
  - o The court emphasized that **ITC would not be available** if the construction of the building is for the **recipient's own use**. This means that if the property is built for **personal use**, the **ITC chain breaks**, and the credits cannot be claimed.
  - o The decision on whether a building qualifies as a **plant** under **Section 17(5)(d)** of the **Central Goods and Services Tax Act, 2017** is a **factual question**.
- **Functionality and Essentiality Test**:
  - o The court introduced a **functionality test** to determine if a building can be classified as a **plant**.
  - o The **role of the building** in the business operations is critical—if the building is **functionally integral** to the business's performance or output, ITC may be available.
  - o For instance, buildings such as **malls, warehouses**, or any structure besides hotels or cinemas may qualify as plants, but this depends on their **use** in the registered person's business.
- **Reasoning for the Judgment**:
  - o Renting or leasing of **immovable property** is considered a **supply of service** under the **CGST Act**. Therefore, if the premises qualify as a **plant**, the **ITC on goods and services** used for setting up the property can be allowed.

This judgment provides clarity on the **conditions and tests** that need to be met for claiming **ITC on construction costs** in the real estate sector, ensuring better compliance with the **CGST framework**.

What is Input Tax Credit (ITC)?
- **Definition**:

- o **Input Tax Credit (ITC)** refers to the tax already paid by a person at the time of purchasing goods or services, which can be used as a **deduction** from the tax payable on sales. It helps to avoid the cascading effect of taxes, i.e., **"tax on tax"**.
- **Mechanism to Avoid Cascading**:
    - o ITC is designed to eliminate **double taxation** on the same product or service at different stages. It ensures that the tax is only levied on the **value addition** at each stage of production or service.
- **Application in GST**:
    - o Under **Goods and Services Tax (GST)**, ITC is available for the **CGST, SGST/UTGST**, or **IGST** charged on the supply of goods or services made to a **registered person**.
    - o **IGST on imports** and tax paid under the **reverse charge mechanism** are also included in the ITC framework.
- **Utilization of ITC**:
    - o When a registered dealer buys goods or services, they pay taxes at the time of purchase.
    - o On selling goods or services, they collect taxes. The **taxes paid during purchases** are adjusted against the **output tax (tax on sales)**.
    - o The **balance tax liability** is calculated as **tax on sales minus tax on purchase**, and the remaining amount must be paid to the government.
    - o This process of adjusting input tax against output tax is called the **utilization of input tax credit**.
- **Refund Mechanism**:
    - o If the tax paid on inputs is higher than the tax on the output, the **excess tax** can be claimed as a **refund**.
- **Exceptions**:
    - o Businesses under the **composition scheme** cannot avail of ITC.
    - o ITC cannot be claimed for goods or services used for **personal purposes** or for **exempted goods**.

Interest Rates Set to Ease: Impact on Borrowers and Savers
Sub : eco

Sec: Monetary Policy

- **Global Rate Reduction Trends**:
    - o **Globally**, central banks like the **U.S. Federal Reserve** and the **European Central Bank** are reducing **interest rates**.
    - o The **Reserve Bank of India (RBI)** has not committed to a rate cut yet, but **widespread expectations** point to rate cuts in the near future.
    - o **Currency Exchange Rate**: The **exchange rate** is currently **stable**.
    - o **Timing of Rate Cut**: The **RBI** may initiate an interest rate cut by **December**.
- **Fundamental Reasons for Rate Reduction**:
    - o **Lower Inflation**: India's **inflation** has **decreased**, allowing room for interest rate cuts.
    - o **Global Rate Reductions**: Major economies are **cutting rates**, and India is likely to follow.
    - o **Stable Currency**: The **exchange rate** is stable, which supports the possibility of interest rate easing.
- **Impact on Borrowers**:
    - o **Floating Rate Loans**:
        - ▪ Loans are often **benchmarked** to external variables like the **RBI repo rate** or **Treasury Bill yields**.
        - ▪ Any **cut in repo rate** will lead to **immediate transmission** to loan rates.
    - o **Options for Borrowers**:
        - ▪ **Option 1**: **Keep EMI the same and reduce the loan tenure**. This helps in reducing the overall **interest paid**.
        - ▪ **Option 2**: **Reduce EMI and keep the loan tenure the same**. Although it eases **cash flow**, it leads to paying more interest over time.
    - o **Fresh Loans**:
        - ▪ **Low floating rates** are attractive but remember, interest rates **move in cycles**.
        - ▪ During the **post-COVID phase**, **floating housing loan rates** had dropped to **6.5%**.
- **Impact on Savers and Depositors**:
    - o **Deposit Rates**:
        - ▪ A cut in the **RBI repo rate** (currently **6.5%**) will lead to **lower deposit rates**.

- The **extent of reduction** depends on banks, but it will likely follow the RBI's rate cut, for example, by **0.5% to 0.75%**.
  - o **Opportunity Cost**:
    - ▪ **Locking in current deposit rates** could prove beneficial, as future rates are expected to be **lower**.
  - o **Other Interest-Bearing Instruments**:
    - ▪ **Small Savings Schemes**: Includes **Post Office Schemes**, **RBI Floating Rate Bonds**, and **government-sponsored retirement schemes**.
    - ▪ **Corporate Deposits and Bonds**: Deposits by **corporates/NBFCs** and **government / corporate bonds** will also see **similar rate movements**.
  - o **Mutual Funds (Debt MFs)**:
    - ▪ In **debt mutual funds**, when **interest rates decline**, bond prices rise, leading to **higher returns**.
    - ▪ The **10-year benchmark government bond yield** has already eased from **7.38%** to **6.75%** over the past year.
- **What Borrowers Should Do**:
  - o **For existing loans**: Consider keeping **EMI the same and reducing tenure** to **minimize total interest paid**.
  - o **For new loans**: Sign up for a loan based on your **capacity**, keeping in mind that **floating rates** may **rise** over time.
- **Conclusion**:
  - o **Borrowers benefit** from lower rates as **loan EMIs decrease** or **tenure shortens**.
  - o **Savers/Depositors** face **lower returns** but can still benefit if they **lock in rates** now.
  - o The **RBI will reduce rates** only when **inflation** is low, ensuring the **real return** (inflation-adjusted) for savers is not **adversely impacted**.

RBI Holds Rate at 6.5% and Shifts Policy Stance to 'Neutral'

Sub : Eco

Sec: Monetary Policy

RBI Maintains Benchmark Rate:

- The **Reserve Bank of India (RBI)** has held the **benchmark interest rate at 6.5%** for the 10th consecutive monetary policy review since April 2023.
- This decision indicates stability in **monetary policy** while opening the possibility for a **rate cut** in the near future.
- **Shift to 'Neutral' Stance**:
  - o The **Monetary Policy Committee (MPC)**, after a three-day meeting starting October 7, unanimously shifted its policy stance from **'withdrawal of accommodation'** to **'neutral'**.
  - o **Five out of six members** voted to maintain the interest rates, while the shift to a neutral stance was **unanimous**.
  - o This shift signals that the RBI is ready to respond flexibly to future changes in economic conditions, particularly inflation and growth.
- **Inflation and Growth**:
  - o **Inflation** and **growth** parameters are currently **well-balanced**, according to the MPC.
  - o **Retail inflation** was close to the **RBI's target of 4%** in **July and August**.
  - o Governor **Shaktikanta Das** mentioned that **inflation** is expected to **reverse in September** and may remain **elevated** due to adverse base effects.
  - o The RBI's **GDP growth projection remains at 7.2%**, and inflation is estimated at **4.5%** for **2024-25**. However, **second-quarter inflation** is revised to **4.1%**, with a projection of **4.8%** for the **October-December quarter**.
- **Inflation Management**:
  - o Das used an analogy, stating that **"the inflation horse has been brought to the stable,"** emphasizing the importance of controlling inflation and preventing it from rising again.
  - o He stressed the need to **keep inflation under control** and **monitor evolving conditions** to confirm **disinflationary impulses**.
- **Key Risks**:
  - o The MPC noted **unanticipated weather events** and **geopolitical conflicts** as major risks that could push inflation upward.
  - o The committee remains **watchful** of the evolving **inflation outlook** in the coming months.

By maintaining the **status quo** on rates but moving to a **neutral stance**, the RBI is signaling a balanced approach toward fostering **sustainable growth** while keeping **inflation within control**.

Monetary Policy Committee (MPC) – Overview:

The **Monetary Policy Committee (MPC)** is a statutory body established to determine India's benchmark interest rates, particularly the **repo rate**, to control inflation and stabilize the economy. It was created as part of a larger framework to introduce **inflation-targeting monetary policy**.

Key Details:

- **Constitution**:
    - The **MPC** was constituted under **Section 45ZB** of the **RBI Act, 1934**, amended by the **Finance Act, 2016**.
    - The MPC was established after a Memorandum of Understanding between the Government of India and the Reserve Bank of India (RBI).
- **Function**:
    - The MPC is responsible for **fixing the benchmark policy rate (repo rate)** to control inflation and ensure price stability.
    - The inflation target is set by the Government of India in consultation with the RBI.
- **Composition**:
- The MPC consists of **6 members**:
    - **RBI Governor** (Chairperson).
    - **RBI Deputy Governor** in charge of monetary policy.
    - One member nominated by the RBI Board.
    - Three members nominated by the **Government of India**.
    - The **external members** nominated by the government serve for a period of **four years**.
    - The decisions are made based on a **majority vote**, with each member having one vote. In case of a tie, the **RBI Governor** holds a **casting vote**.
- **Quorum**:
    - The quorum for the MPC's meeting is **four members**, and one of them must be either the **Governor** or the **Deputy Governor** of the RBI.
- **Binding Decisions**:
    - The decisions made by the MPC are **binding on the RBI**.
    - RBI's **Monetary Policy Department (MPD)** assists the MPC by providing technical analysis and policy advice.
- **Replacement of the Technical Advisory Committee**:
    - The MPC replaced the earlier **Technical Advisory Committee** (TAC), where the RBI Governor had discretion to seek the opinion of a group of advisors before making a monetary policy decision. The MPC formalized and institutionalized this process by granting decision-making authority to the Committee.

The MPC plays a crucial role in shaping India's monetary policy, contributing to **economic stability**, influencing **borrowing costs**, and maintaining **price stability**, which impacts investments, savings, and consumption in the economy.

Summary of Policy Stances

Policy Stance	Objective	Interest Rates	Liquidity	Economic Growth	Inflation Control
Withdrawal of Accommodation	Control inflation, stabilize economy	Increase	Decrease	Slow	High
Neutral	Maintain economic stability	Maintain	Stable	Sustain	Balanced
Accommodative	Stimulate economic growth	Decrease	Increase	Accelerate	Potential Rise
Contractionary	Reduce inflation, prevent overheating	Increase	Decrease	Slow	High
Hawkish	Control inflation	Often Increase	Often Decrease	May Slow	High
Dovish	Stimulate growth	Often Decrease	Often Increase	Accelerate	Potential Rise

RBI Proposes New Repository to Address Climate Risk Data Gaps

Sub : Eco

Sec: Monetary Policy

- **Introduction of RB-CRIS**:
  - The **Reserve Bank of India (RBI)** has proposed a new **data repository** called the **Reserve Bank – Climate Risk Information System (RB-CRIS)**.
  - The repository aims to bridge the existing **gaps in climate-related data** for financial and other regulated entities.

RBI - Climate Risk Information Repository (RB-CRIS)

The **Reserve Bank of India (RBI)** is launching the **Climate Risk Information System (RB-CRIS)** to enhance the resilience of the financial system against **climate change risks**. This system will address the increasing impact of climate-related risks on financial stability and provide a standardized data repository.

Key Features of RB-CRIS:

- **Purpose**:
  - RB-CRIS will help regulated entities conduct **climate risk assessments** by providing high-quality, **standardized climate data**.
  - It aims to address current data gaps that are often **fragmented and lack granularity** necessary for comprehensive assessments.

- **Two-Part Structure**:
  - **Public Web Directory**: This will list various climate data sources and be **accessible to the public** via the RBI's website.
  - **Secure Data Portal**: This will house **processed climate-related datasets** in standardized formats. Access will be restricted to **regulated entities** to improve their climate risk assessments.

- **Phased Launch**:
  - The rollout will begin with the **web-based directory**, followed by a gradual introduction of the **data portal** for regulated entities to ensure smooth adaptation.

- **Disclosure Framework**:
  - On **February 28, 2024**, the RBI introduced draft guidelines for a **'Disclosure Framework on Climate-Related Financial Risks'**, requiring regulated entities to disclose climate-related risks across four areas:

- **Governance**
- **Strategy**
- **Risk Management**
- **Metrics and Targets**
  - The framework helps inform stakeholders (regulators, investors, customers) about **climate risks** and strategies to manage them.

- **Staggered Adoption**:
  - The RBI has given regulated entities **additional time** to establish internal policies and mechanisms for reporting climate-related disclosures.
  - The **disclosure requirements** vary based on the **size and complexity** of the entities, with **basic** disclosures mandatory for all, while **enhanced disclosures** remain voluntary for smaller entities.

This initiative aims to make **climate risk data more accessible and actionable** for financial entities, contributing to stronger **climate resilience** within India's financial system.

RBI Orders 'Cease and Desist' on 4 NBFCs Over Usurious Pricing and Regulatory Deviations

Sub: Eco

Sec: Monetary Policy

- **Action by RBI**:
  - The **Reserve Bank of India (RBI)** has issued a **'cease and desist' order** to **four non-banking financial corporations (NBFCs)**.
  - The action is taken due to **usurious pricing** and **other regulatory violations** observed in their lending practices.

- **NBFCs Involved**:
  - The four NBFCs named by the RBI are:
    - **Asirvad Micro Finance Ltd.** (MFI arm of Manappuram Finance Ltd.)

- - ▪ **Arohan Financial Services Ltd.**
    - ▪ **DMI Finance Private Ltd.** (backed by Mitsubishi UFJ Financial Group)
    - ▪ **Navi Finserv Ltd.**
  - **Reasons for Action**:
    - o **Material supervisory concerns** were noted in the **pricing policy** of these companies, particularly their **Weighted Average Lending Rate (WALR)** and the **interest spread** over their cost of funds.
    - o Violations were identified in several areas:
      - ▪ **Usurious pricing** practices.
    - o Non-compliance with **regulatory guidelines** on:
      - ▪ Assessment of **household income**.
      - ▪ Consideration of **existing or proposed monthly repayment obligations** in microfinance.
    - o Additional deviations, including:
      - ▪ **Evergreening of loans** (renewing or extending loans to avoid recognizing defaults).
      - ▪ Practices related to the **gold loans portfolio**.
      - ▪ **Mandated disclosure** requirements for interest rates and fees.
      - ▪ **Outsourcing of core financial services**, contrary to regulatory norms.
    - o **Implementation of Restrictions**:
      - ▪ The **business restrictions** on these NBFCs will take effect from **October 21, 2024**.
      - ▪ These curbs will **not affect services to existing customers**.
      - ▪ The restrictions will be **reviewed** once the RBI is satisfied with the **remedial actions** taken by these companies.
    - o **Response from NBFCs**:
      - ▪ **Navi Finserv** and **Asirvad Microfinance** have acknowledged the RBI's action:
      - ▪ They have stated that they **value the feedback** and will work towards addressing the concerns raised.
      - ▪ **Asirvad** has called for an urgent **board meeting** to monitor and implement **corrective actions** within a **time-bound plan**.
    - o **Implications**:
      - ▪ This regulatory action underscores the RBI's commitment to **protect borrowers** from **unfair lending practices**.
      - ▪ It highlights the importance of **strict compliance** with guidelines to ensure **ethical conduct** and **transparency** in financial services.

Evergreening of Loans

Evergreening loans is a practice where **new or additional loans** are extended to borrowers who are **unable to repay existing loans**. This method effectively **conceals the actual status** of **non-performing assets (NPAs)** or **bad loans**. It is often referred to as a form of **zombie lending**, as it allows financially distressed borrowers to continue operating without addressing underlying financial issues.

The Rise and Fall of P2P Lending in India
Sub: Eco
Sec: Monetary Policy

- **Peer-to-Peer (P2P) Lending** is a form of financial technology (fintech) that allows individuals to lend and borrow money directly from one another **without the involvement of traditional financial institutions like banks.**
- **Peer-to-Peer (P2P) lending** emerged as an **alternative lending mechanism** allowing direct transactions between lenders and borrowers without involving traditional financial institutions.
- P2P platforms provided **tenure-linked assured returns** and **liquidity options**, which attracted many investors, making it a popular choice for informal lending in India.
- Every P2P lender should obtain a **certificate of registration from the RBI.**
- The **minimum capital requirement to set up a P2P platform is fixed at Rs. 2 Crores.**

How P2P Lending Works:

- **Platform Role:** P2P lending platforms operate as **intermediaries, connecting borrowers with lenders.** These platforms assess the creditworthiness of borrowers, set interest rates, and facilitate the loan transactions.

- **Borrowers:** Individuals or **small businesses can apply for loans on these platforms**. The loans can be used for various purposes such as personal loans, business loans, debt consolidation, or even real estate.
- **Lenders:** Individuals or institutional investors can **lend money to borrowers in exchange for interest payments. Lenders can often choose specific borrowers** or diversify their investments across multiple loans to reduce risk.

Regulatory Framework:

- In **2016**, due to the rise in informal money-lending and global growth of P2P lending, the **RBI** initiated discussions on whether to **regulate the sector**.
- Concerns included the possibility of:
    - Lending legitimacy to P2P lending, **stifling growth**, and the **absence of systemic risks**.
    - After **feedback from stakeholders**, the **RBI issued master directions in 2017**, specifying:
    - **Scope of activities** for P2P lenders.
    - **Eligibility criteria** for participants.
    - **Transparency** and **pricing disclosure** requirements.

What Went Wrong?

- According to an **RBI official**, P2P platform began to **operate like banks**, **pocketing the spread** between the borrowing rate and the interest charged, leading to **regulatory intervention**.

Key issues identified:

- **Utilization of funds:** P2P platforms were found to be using **funds of one lender** to replace those of another, mimicking a **secondary market** behavior, which was prohibited.
- **Fee disclosure:** Lack of **clear fee disclosures** led to regulatory action mandating platforms to **disclose fees upfront**.
- **Closed user groups:** The practice of **matching and mapping participants** within **closed user groups** through outsourcing was banned by the RBI.

Sri Lanka's economy marks first deflation in 39 years

Sub : Eco

Sec: Inflation and Unemployment

Context:

- Sri Lanka's economy recorded **falling consumer prices for the first time in 39 years**, with the September inflation figure dipping to **negative 0.5%.** Sri Lanka last recorded deflation in 1985.

Inflation in Sri Lanka:

- In 2022, inflation in Sri Lanka **peaked at 69.8%** at the height of an unprecedented economic crisis marked by an acute shortage of food, fuel and medicines.
- The crisis was exacerbated by political instability and public unrest.
- The government has implemented various measures, including adjusting interest rates and seeking assistance from international organizations like the IMF, to stabilize the economy and control inflation.

Inflation:

- Inflation refers to the **rise in the prices of most goods and services** of daily or common use, such as food, clothing, housing, recreation, transport, consumer staples, etc.
- Inflation measures the **average price change in a basket of commodities** and services over time.
- Inflation is indicative of the **decrease in the purchasing power** of a unit of a country's currency. This could ultimately lead to a deceleration in economic growth.
- However, a moderate level of inflation is required in the economy to ensure that production is promoted.
- In India, inflation is primarily measured by two main indices, **WPI & CPI** which measure wholesale and retail-level price changes, respectively.
- As per RBI, **inflation target of 4 per cent with a +/-2 per cent tolerance band** is set for 2021-2025 period.

Deflation:

- Deflation happens when the **general price level of goods and services decreases**, and the **inflation rate falls below 0%.**
- Deflation **increases the value of currency**, allowing people to buy more goods and services with the same amount of money.

Deflation vs Disinflation:

- Disinflation refers to a **decrease in the level of inflation** whereas deflation implies negative inflation.

Causes of Deflation:

- **Decreased money supply**
- **Decreased consumer demand**
- **Increased productivity**
- **Unemployment**
- **Debt deflation**

Effects of deflation include:

- **Lower spending and investment**
- **Higher unemployment**
- **More difficult debt repayment**
- **Bank runs**

Rising Tomato Prices Trigger Fresh Concerns Over Food Inflation Amid Festive Season

Sub: Eco

Sec: Inflation

Why in News

Food inflation in India has spiked, primarily due to a **sharp rise in the price of vegetables, especially tomatoes.** This surge is driven by reduced supply in markets and increased demand during the festive season, causing concern among households. The Centre has intervened by selling tomatoes at reduced prices to stabilize the situation.

Factors Behind the Price Surge

Excessive rainfall in September has severely impacted tomato supplies, with mandi arrivals dropping by more than half compared to August.

The ongoing festive season has led to an increase in demand, exacerbating the price pressure. Tomatoes have crossed the **₹100 per kilogram** mark in many cities, further straining household budgets.

In contrast, prices for other key vegetables such as **onions and potatoes** remain elevated, adding to the burden of food inflation

What is Inflation?

Inflation refers to the general increase in the prices of goods and services over time, leading to a decrease in the purchasing power of money.

Inflation is typically measured using indices like the **Consumer Price Index (CPI)** or **Wholesale Price Index (WPI)**.

Can result from **demand-pull factors** (increased demand), **cost-push factors** (higher production costs), or **monetary factors** (excess money supply).

What is Food Inflation?

Food inflation specifically refers to the rise in the prices of food items, leading to increased costs for consumers.

Caused by factors like **supply disruptions**, **seasonal fluctuations**, **weather conditions** (e.g., drought, floods), and **market demand**.

Part of the overall **Consumer Price Index (CPI)** but focuses solely on the prices of food products.

About Consumer Food Price Index (CFPI)

The **Consumer Food Price Index (CFPI)** measures changes in the retail prices of food items consumed by households. It tracks the inflation rate specific to food products, such as cereals, pulses, fruits, vegetables, meat, and dairy.

The CFPI is a subset of the **Consumer Price Index (CPI)**, focusing solely on the food component. Helps monitor **food inflation** and its impact on household expenditure and purchasing power.

Cost-push inflation occurs when overall prices increase (inflation) due to increases in the **cost of wages and raw materials**. Higher costs of production can decrease the aggregate supply (the amount of total production) in the economy. Since the demand for goods hasn't changed, the price increases from production are passed onto consumers creating cost-push inflation.

Demand-pull inflation is the upward pressure on prices that follows a shortage in supply, a condition that economists describe as **"too many dollars chasing too few goods. ""When demand surpasses supply, higher prices are the result."**

The main causes of inflation:

Monetary Policy: It determines the supply of currency in the market. Excess supply of money leads to inflation. Hence decreasing the value of the currency.

Fiscal Policy: It monitors the borrowing and spending of the economy. Higher borrowings (debt), result in increased taxes and additional currency printing to repay the debt.

Demand-pull Inflation: Increases in prices due to the gap between the demand (higher) and supply (lower).

Cost-push Inflation: Higher prices of goods and services due to increased cost of production.

Exchange Rates: Exposure to foreign markets is based on the dollar value. Fluctuations in the exchange rate have an impact on the rate of inflation.

The effects of a rise in the inflation rate:

A rise in an inflation rate can cause more than a **fall in purchase power.**

Inflation could lead to **economic growth** as it can be a **sign of rising demand.**

Inflation could further lead to an **increase in costs due to workers demand to increase wages to meet inflation.** This might increase unemployment as companies will have to lay off workers to keep up with the costs.

Domestic **products might become less competitive** if inflation within the country is higher. It can weaken the currency of the country.

Prevent inflation:

To prevent inflation, the primary strategy is to change the monetary policy by adjusting the interest rates. **Higher interest rates decrease the demand in the economy**. This results in lower economic growth and therefore, lower inflation. Other ways to prevent inflation are:

Controlling the money supply can also help in preventing inflation.

Higher Income Tax rate can reduce the spending, and hence resulting in lesser demand and inflationary pressures.

Introducing policies to increase the **efficiency and competitiveness** of the economy helps in reducing the long-term costs.

India's energy demand to triple by 2050

Sub: Eco

Sec: Infrastructure

Context:

- **India's GDP growth is 7%**, and **power demand** has **risen** by over **8%** this year.
- **India** is now the **third-largest power market globally.**
- **Energy demand in India** is expected to **triple by 2050,** making the country a crucial investment destination.

India's Growing Role in Global Energy Transition:

- **India's economy** has surpassed **the UK** and **France** and is on track to overtake **Germany** and **Japan** within the **next 5–10 years.**
- By 2030, India is expected to have over **200 GW of solar and wind capacity.**
- **India** has emerged as the **second-largest solar module manufacturer,** exporting to key global markets.

Coal and Nuclear in India's Energy Mix

- Despite rapid growth in **renewables, 70%** of **India's power** still comes from **coal.**
- **By 2030, India** will have **50 GW** of **coal** and **10 GW** of nuclear capacity.
- In a **net-zero scenario,** electrification would need to **exceed 50%**, balancing fossil fuel and electric economies.

Challenges in Energy Transition

- Key challenges include **energy storage, grid infrastructure,** and **renewable energy deployment.**
- **Leveraging domestic market strength** and **global partnerships** is **critical** for driving a **low-carbon future.**

Global Climate Milestone

- **A major climate milestone in 2023:** for the first time, global surface temperatures **exceeded 2°C above pre-industrial levels**.
- **Greenhouse gas emissions** have not peaked, indicating continued temperature rise.
- **India** is a key player in the **global energy transition,** with more solar and wind projects than coal plants expected by **2030.**

Battery Energy Storage & Electrification:

- The intermittency of renewable energy poses challenges, making **Battery Energy Storage Systems (BESS)** essential for **grid stability**.
- **Global energy demand** is expected to **triple by 2050,** driven by advancements in storage technology.
- **Batteries** are crucial for both the **power sector** and **electric mobility.**

India's Electric Mobility Sector:

- **India's electric vehicle market** is growing rapidly, with major automakers setting up battery assembly plants.
- The **Production Linked Incentive (PLI) scheme** is helping create **50 gigawatt hours of battery manufacturing capacity.**

- **Lithium-ion battery demand** is expected to rise from **10 GWh today** to **200 GWh by 2035**.
- In **India,** the production capacity of **Lithium-ion battery** is expected to reach **150 GWh by 2030**, covering **13%** of total cell demand.

Government initiative:

1. **Ministry of Heavy Industries (MHI)**, in **June, 2021** launched a **Production-Linked Incentive (PLI) scheme** for the manufacturing of **Advanced Chemistry Cell (ACC) battery storage** of **50 GWh capacity,** which includes more than **10 GWh grid-scale battery storage**.
   o The **PLI-ACC scheme** has an outlay of **Rs 18,100 Crores.**
2. The Government has approved the scheme for **Viability Gap Funding (VGF)** for the development of **Battery Energy Storage Systems (BESS)** with a capacity of **4,000 megawatts hours (MWh) by 2030-31**.
   o By offering VGF support, the scheme targets achieving a Levelized Cost of Storage (LCoS) ranging from Rs. 5.50-6.60 per kilowatt-hour (kWh), making stored renewable energy a viable option for managing peak power demand across the country.

Galathea Bay: A Strategic Game-Changer in Maritime Trade

Sub : Eco

Sec: Infrastructure

Why in News

Galathea Bay, located on the Great Nicobar Island, has been notified as **India's 13th major port. The International Container Transshipment Port (ICTP)** proposed here could potentially transform maritime trade in the region.

Strategic Importance of Galathea Bay Port:

Location and Trade Route: Galathea Bay, situated on the **Great Nicobar Island in the Bay of Bengal,** is strategically positioned along the **East-West international shipping and trade route.** It lies close to major transshipment hubs such as **Singapore, Colombo, and Klang,** making it a key location for capturing cargo from Indian east coast ports, as well as from **Bangladesh and Myanmar.**

Proximity to Global Shipping Channels: The port is located **40 nautical miles from the Malacca Strait, which handles 35% of the world's annual sea trade.** Presently, 75% of India's transshipped cargo is routed through foreign ports, with Colombo alone handling 45% of this. The development of the **ICTP at Galathea Bay can help Indian ports save $200-220 million annually** in transshipment charges.

Reduction in Transshipment Costs: At present, India's transshipment cargo is predominantly handled by foreign ports, leading to substantial outflow of revenue. The **Galathea Bay port can significantly reduce transshipment costs and improve the efficiency** of Indian maritime trade.

Boost to the Indo-Pacific Region: As part of the **evolving Indo-Pacific geopolitical region,** this port can act as a **gateway for trade and security,** increasing India's presence and influence in the region.

Four-Phase Development Plan:

The **ICTP** is planned to be developed in **four stages** with an estimated total cost of **₹41,000 crore.**

Phase 1, scheduled for **completion** in **2028,** is expected to have a handling **capacity of 4 million TEUs** (Twenty-foot Equivalent Units), with the final stage scaling up to 16 million TEUs.

Phase 1 alone will require ₹18,000 crore for dredging, reclamation, breakwater construction, and development of core infrastructure.

Phase 2: Gradual increase in **capacity beyond the initial 4 million TEUs.** Additional berths and expansion of logistical and operational facilities.

Phase 3: Scaling up to a **more advanced cargo handling capability.** Further enhancements in equipment procurement and operational efficiencies to handle larger shipments.

Phase 4: Full-scale development to reach 16 million TEUs. Aimed at establishing the port as a major global transshipment hub.

About Kamarajar Port: India's 12th Major Port

Kamarajar Port, located in **Ennore, Tamil Nadu**, was declared India's 12th major port in **March 1999**.

This port was the **first corporatized major port in India,** functioning as a public sector company with **100% equity held by the government**.

The port was named after **K. Kamaraj**, a prominent Indian politician and former Chief Minister of Tamil Nadu, in recognition of his contribution to public welfare and development.

Located on the **Coromandel Coast**, Kamarajar Port primarily serves the industrial and commercial needs of Tamil Nadu.

Its strategic position near **Chennai Port** has allowed it to function as a satellite port to ease the congestion at Chennai, handling bulk and liquid cargo, including coal, iron ore, and petroleum products.

Ports In India

- India previously had 12 major seaports (11 Government-owned and one private) and 205 notified minor and intermediate ports that handle a huge volume of traffic.
- About 95 percent by volume and 70 percent by value of India's total international trade are carried on through maritime transportation.
- All ports in India are situated in the 9 coastal states of India namely Kerala, Karnataka, Maharashtra, Goa, Gujarat, West Bengal, Odisha, Andhra Pradesh, and Tamil Nadu.
- Mumbai is the largest natural port in India.
- While the Major Ports are under the administrative control of Ministry of Shipping, the non-major ports are under the jurisdiction of respective State Maritime Boards/ State Government.

India to Establish Its First Coal Exchange

Sub: Eco

Sec: Infra

Overview:

- Union Coal and Mines Minister announced that India's **first coal exchange** is set to be established soon.

Key Features and Objectives:

- **Online Trading Platform:**
    - The coal exchange will be an **online trading platform** that allows coal to be traded like any other commodity.
    - It will include a **clearing and settlement mechanism**, ensuring smooth transactions and **easy availability** of coal in the market.
- **Market Liberalization:**
    - The introduction of the exchange is part of the **Coal Ministry's action plan for 2024-25** to **open up the coal market**, making it more transparent and competitive.
    - This initiative is expected to attract more **sellers and buyers**, improving the efficiency of coal distribution across the country.
- **Regulation and Supervision:**
    - The **Coal Controller Organisation** will supervise the operations of the coal exchange, ensuring adherence to **regulatory norms**.
    - The minister also mentioned that if necessary, India would consider **importing coking coal from Russia** to meet domestic demand, especially for steel manufacturing.

Implications:

- **Enhanced Market Dynamics:**
    - The coal exchange is likely to **streamline coal trading**, reducing reliance on traditional supply chains and improving accessibility for various industries.
    - By introducing a **formal market platform**, it aims to provide more **price transparency** and **efficient coal procurement**.
- **Reduced Bottlenecks:**
    - With **online trading**, issues related to **supply bottlenecks** can be minimized, ensuring that coal reaches buyers across different regions without significant delays.
- **Support for Industrial Growth:**
    - The exchange can contribute to the **growth of industries** dependent on coal by providing a **steady and reliable supply**, crucial for sectors like **power generation** and **steel production**.

Coal Controller Organisation

Coal Controller Organisation, Ministry of Coal collects and maintains coal production data of all private and public sector coal mines in the country. The information is collected on monthly basis.

To ensure fair production and commercial transaction, Coal Controller Organisation, a subordinate office under Ministry of Coal, has been entrusted with the following responsibilities:

- Inspection of collieries so as to ensure the correctness of the class, grade or size of coal.
- To issue directives for the purpose of declaration and maintenance of grades of coal of a seam mined in a colliery.
- To act as the appellate authority in case of dispute between consumers and owner arising out of declaration of grade and size of coal.
- To regulate disposal of stock of coal or the expected output of coal in the colliery.

- Quality surveillance with respect to maintenance of grade, loading of coal in wagons/ trucks according to laid down procedures regarding grades and sizes.
- To grant opening / re-opening permission of coal mine, seam or a section of seam or to sub-divide a mine.
- Assessment and collection of excise duty levied on all raw coal raised and dispatched.
- Submission of monthly coal data to different ministries of Central and State Government, national and international organization.

Directorate General of Mines Safety [DGMS] is the Indian Government Regulatory agency for safety in mines. The mission of the DGMS is to continually improve safety and health standards, practices and performance in the mining industry and upstream petroleum industry by implementing pro-active safety and health strategies, continuous improvement of processes, effective use of resources and commitment and professional behaviour in its personnel.

India's Per Capita Income to Rise by $2000 in 5 Years
Sub: Eco

Sec: National Income

- **Finance Minister's Statement**:
  - Finance Minister **Sitharaman** stated that the coming decades will see the **steepest rise** in living standards for Indians, marking a significant period for the country's development.
- **Per Capita Income Projection**:
  - India's **per capita income** is projected to increase by **$2,000** over the next five years.
  - As per **IMF projections**, it took **75 years** to reach the current per capita income of **$2,730**, but adding another $2,000 will take only **five years**.
- **Reduction in Inequality**:
  - **Inequality in India** has declined, as reflected in the **Gini Coefficient**, which measures income inequality:
    - In **rural areas**, it improved from **0.283** to **0.266**.
    - In **urban areas**, it improved from **0.363** to **0.314**.
- **Impact of Economic Reforms**:
  - The improvements in inequality are expected to continue as the effects of the **last 10 years of economic and structural reforms** become more visible in the data, especially as the impact of the **Covid shock** fades.
- **Fiscal Discipline Commitment**:
  - The government is committed to **reducing the fiscal deficit**:
    - The fiscal deficit is estimated to decline from **5.6% of GDP** in FY24 to **4.9% of GDP** in FY25.
    - Fiscal discipline will help control **bond yields** and reduce **borrowing costs** across the economy.
- **Capital Expenditure Growth**:
  - **Capital expenditure** is budgeted to increase by **17.1%** to **₹11.1 lakh crore** in FY25, which amounts to **3.4% of GDP**.
  - A larger proportion of the fiscal deficit is now allocated to **capital outlays**, indicating a focus on **investment-oriented deficit financing**.
- **Lowering of Subsidies**:
  - A decline in **commodity prices** has allowed for reduced allocations for **fertilizer and fuel subsidies**, contributing to **restrained revenue expenditure growth**.
  - Revenue expenditure is projected to grow by **6.2%** year-on-year.
- **India's Economic Performance**:
  - India's **economic performance** over the past decade has been notable, with the country **leapfrogging from the 10th to the 5th largest economy** in just five years.
  - The economy has maintained **high growth rates** and **inflation** within a **comfortable range**, providing a solid foundation for future growth.

Gini Coefficient:

- The **Gini Coefficient** measures income inequality in a country, ranging from **0 to 1**.
  - A **0** represents perfect equality (everyone has the same income).
  - A **1** represents maximum inequality (one person has all the income).

Fiscal Deficit:

- **Fiscal Deficit** occurs when a government's **expenditures** exceed its **revenues** (excluding borrowings). It indicates the amount of borrowing required to meet the gap.

Bond Yield:

- **Bond Yield** is the return an investor earns on a bond. **It is inversely related to the bond price**. As bond prices fall, yields rise, and vice versa.

Deficit Financing:

- **Deficit Financing** refers to a government funding its excess expenditures over revenue by **borrowing** or creating new money, often through the issuance of government bonds.

Nobel Prize in Economics 2024: Acemoglu, Johnson, and Robinson Recognized for Work on Wealth Inequality

Sub : Eco

Sec : National Income

- **Award and Recipients**:
    - The **Nobel Prize in Economics** for 2024 was awarded to **Daron Acemoglu, Simon Johnson, and James Robinson**.
    - **Daron Acemoglu** is a **Turkish-American economist**, while **Simon Johnson and James Robinson** are **British-Americans**.
    - Acemoglu and Johnson are professors at the **Massachusetts Institute of Technology (MIT)**, and Robinson is a professor at the **University of Chicago**.
- **Research Focus**:
    - The trio was recognized for their **research on wealth inequality between nations**.
    - Their work examined how **political and economic systems** introduced by **European colonizers** affected the development of societies.
    - The research emphasized the **relationship between societal institutions and prosperity**, showing how the nature of institutions can lead to differences in wealth and economic outcomes.
- **Importance of Societal Institutions**:
    - The Nobel committee highlighted the importance of **inclusive institutions** in driving **economic growth and prosperity**.
    - The chair of the Nobel committee, **Jakob Svensson**, stated that **reducing income differences** between countries remains one of the biggest challenges today, and the laureates' work demonstrates the critical role of **institutions** in achieving this goal.
- **Key Insights from the Research**:
- **Political and Economic Institutions**:
    - The laureates' research illuminated how differences in **political and economic institutions** explain why some nations prosper while others lag behind.
    - For instance, countries with **inclusive political systems** tend to provide better opportunities for economic participation and wealth creation.
    - By contrast, **extractive institutions** often limit growth and trap countries in cycles of low economic development.
- **Example of Nogales**:
    - The Nobel jury cited the example of **Nogales**, a city divided by the **U.S.-Mexican border**.
    - Residents on the **U.S. side** of Nogales have access to better economic opportunities, education, and political rights than those on the **Mexican side**.
    - This example illustrates how **institutions, not geography or culture**, create significant differences in prosperity.
- **Impact on Democratic Systems**:
    - According to **Daron Acemoglu**, their research **favors democracy**.
    - He emphasized that **democracies** tend to grow faster than **non-democratic regimes**, especially when a country transitions from a non-democratic to a democratic system.
    - Acemoglu stated, "*Countries that democratize grow faster, and it's a substantial gain.*"
- **Books and Publications**:
    - Acemoglu is also known for his bestselling book, **"Why Nations Fail: The Origins of Power, Prosperity, and Poverty,"** co-authored with James Robinson.

- o The book explores why some nations succeed economically while others remain poor, linking success to **inclusive institutions** that encourage innovation, education, and participation.
- **Broader Implications**:
  - o The laureates' research has contributed to understanding why **poorer countries struggle to close the income gap** with wealthier nations.
  - o **Jan Teorell**, a professor of political science and a member of the award committee, noted that much of the income gap is due to **differences in economic and political institutions**.
  - o Their work also explains why some nations become **trapped in low economic growth**, and how institutional reforms can help nations escape such traps.

Nobel Prize Winners on Wealth Inequality: Inclusive vs. Extractive Institutions and Colonial Legacies

Sub : Eco

Sec : National Income

The **2024 Nobel Prize in Economics** was awarded to **Daron Acemoglu**, **Simon Johnson**, and **James A. Robinson** for their ground-breaking research on *how institutions influence the prosperity of nations.* Their work provides deep insights into why some countries thrive economically while others remain impoverished.

Why Are Some Countries Rich and Others Poor?

According to the Nobel laureates, the primary reason behind the economic disparity between nations lies in the **quality of their political and economic institutions**.

- **Institutional Quality**:
  - o **Inclusive Institutions**: Promote **economic growth** and **higher living standards** by ensuring **secure private property rights**, **democratic governance**, and **broad political freedoms**.
  - o **Extractive Institutions**: Hinder economic development through **insecure property rights**, **centralized power**, and **limited political freedoms**, which stifles innovation and equitable growth.
- **Impact on Prosperity**:
  - o Countries with **inclusive institutions** tend to have **sustained economic growth** and **higher average incomes**.
  - o Conversely, those with **extractive institutions** experience **economic stagnation** and **persistent poverty**.
- **Empirical Evidence**:
  - o The laureates' studies demonstrate a strong correlation between **inclusive institutions** and **long-term economic success**, whereas **extractive institutions** lead to **economic decline** and **inequality**.

Difference Between 'Inclusive' and 'Extractive' Institutions

The distinction between **inclusive** and **extractive** institutions is central to understanding economic disparities:

- **Inclusive Institutions**:
  - o **Definition**: Institutions that provide **secure private property rights**, **rule of law**, **democratic governance**, and **broad political participation**.
- **Characteristics**:
  - o **Secure Property Rights**: Protect individuals' assets, encouraging investment and innovation.
  - o **Democratic Governance**: Ensures that leaders are accountable to the populace, fostering fair policies.
  - o **Political and Economic Freedom**: Allows individuals to pursue their interests, leading to diverse economic activities.
- **Economic Impact**:
  - o Promote **investment**, **entrepreneurship**, and **efficient resource allocation**.
  - o Lead to **higher productivity** and **sustainable economic growth**.
- **Extractive Institutions**:
  - o **Definition**: Institutions that concentrate power and wealth in the hands of a few, limiting broad-based economic participation.
- **Characteristics**:
  - o **Insecure Property Rights**: Allow the state or elites to seize assets without fair compensation.
  - o **Centralized Power**: Limits political competition and accountability.
  - o **Restricted Freedoms**: Suppresses dissent and limits individuals' ability to influence policy.
- **Economic Impact**:
  - o Discourage **investment** and **innovation** due to lack of security.

o Lead to **inefficient resource allocation** and **economic stagnation**.

Why Did Colonial Powers Set Up Extractive Systems in Some Colonies and Inclusive Ones in Others?

The Nobel laureates explored the historical context of **colonialism** to explain the establishment of different institutional frameworks:

- **Colonial Objectives**:
- **Extractive Systems**:
- Implemented in regions where **colonial powers** had **limited interest in long-term settlement**.
- Aimed at **resource extraction** and **short-term economic gains** without fostering local economic development.
- Example: **British India** – Institutions were designed to **plunder resources** and **maintain control**, hindering long-term prosperity.
- **Inclusive Systems**:
    o Established in areas where **colonial powers** intended to **settle permanently** and **invest in local infrastructure**.
    o Focused on **economic development** and **institutional strengthening** to support sustainable growth.
    o Example: **United States** – British-established institutions promoted **property rights** and **democratic governance**, laying the foundation for long-term economic success.
- **Decision Factors**:
    o **Mortality Rates and Geography**: In regions with **harsh climates** or **high mortality rates**, colonizers preferred **extractive institutions** due to the **impracticality of long-term settlement**.
    o **Economic Incentives**: Areas rich in **natural resources** were often subjected to **extractive systems** to maximize **resource exploitation** without investing in local development.
- **Long-Term Consequences**:
    o **Extractive Institutions**: Resulted in **persistent economic challenges** and **wealth inequality** that continue to affect former colonies today.
    o **Inclusive Institutions**: Enabled **stable economic growth** and **higher living standards**, contributing to the prosperity of countries like the **United States**.

Cyclical slowdown

Sub: Eco

Sec: National Income

Context: India's economy has likely entered a cyclical growth slowdown and growth may slip below 6.7% in the face of emerging risks - Nomura economists

Details:

Cyclical and structural slowdowns are terms often used to describe the nature and causes of an economic slowdown. Here's a breakdown of each:

Cyclical Slowdown

- **Definition**: A cyclical slowdown occurs due to fluctuations in the **economy's business cycle,** which has phases of expansion, peak, recession, and recovery.
- **Cause**: It is typically driven by short-term factors like changes in consumer demand, interest rates, inflation, and business investment levels.
- **Duration**: Cyclical slowdowns are usually temporary, as economies move through business cycles over time.
- **Example**: During a recession, consumer spending declines, leading to decreased production and economic growth. However, this trend usually reverses as monetary and fiscal policies are introduced to stimulate demand.

Structural Slowdown

- **Definition**: A structural slowdown is a more prolonged and fundamental decline in economic growth, resulting from deep-rooted changes in the economy.
- **Cause**: It stems from long-term issues such as demographic changes (aging population), low productivity, outdated infrastructure, or shifts in global trade patterns.
- **Duration**: Structural slowdowns are often long-lasting and require significant changes or reforms in economic policy, labour markets, or technology to resolve.
- **Example**: In an economy heavily dependent on a single industry, like manufacturing, a structural slowdown might occur if there's a global shift toward automation, making labor-intensive manufacturing less competitive.

Key Differences

- **Nature of Causes**: Cyclical slowdowns are due to **short-term business cycle factors,** while structural slowdowns are due to **fundamental issues.**
- **Policy Response**: Cyclical slowdowns can often be managed with short-term policies like **interest rate adjustments.** Structural slowdowns, however, require **long-term reforms.**
- **Reversibility**: Cyclical slowdowns tend to self-correct, while structural slowdowns require significant economic restructuring for reversal.

In short, a cyclical slowdown is like a temporary dip in economic activity, while a structural slowdown indicates deeper, longer-term challenges that require structural reforms.

Business Confidence Index (BCI) Dips in Q2 of 2024-25: Key Insights from NCAER-NSE Survey

Sub : Eco

Sec: Msc

Why in News

The **Business Confidence Index (BCI)**, which gauges the growth prospects and sentiment of industries, saw a significant dip in the **second quarter (Q2) of 2024-25**. This comes after two quarters of improvement, highlighting concerns about the economic outlook.

About Business Confidence Index (BCI):

The **Business Confidence Index (BCI)** is a key economic indicator reflecting the level of confidence businesses have in the economy's future performance.

The **National Council for Applied Economic Research (NCAER)** and the **National Stock Exchange (NSE)** release the **Business Confidence Index (BCI) in India.** The BCI is based on a quarterly survey of over **500 companies** in **six major cities in India.** The survey covers a range of topics, including:

- **Firm characteristics**
- **Expectations for changes in costs**
- **Labor employment and wages**
- **Inventories**
- **Prospects for sales, exports, and imports**
- **Profits**

The survey also includes a **Political Confidence Index (PCI)** that measures business confidence in **India's political management of economic policies.**

The BCI is measured through four primary components:

Overall Economic Conditions: Businesses are surveyed on whether they expect the **overall economic conditions** to improve in the next six months. A decline in optimism was evident in Q2.

Firm's Financial Position: Firms were asked about the prospects of their **financial position improving** over the next six months, with expectations showing a downward trend in Q2.

Present Investment Climate: Sentiment regarding the **present investment climate** was also part of the index, reflecting industry's views on investment opportunities.

Capacity Utilisation: The survey also considered whether firms believed their **capacity utilisation** was close to or above the optimal level. A weaker response in this area contributed to the overall dip in confidence.

Economic Context and Outlook

The reversal of business confidence in Q2 can be attributed to growing concerns over **macroeconomic factors**, including **inflation**, **global economic uncertainties**, and **domestic policy challenges**.

While the BCI was on a growth trajectory in previous quarters, the sharp moderation signals caution among firms regarding the **near-term economic outlook**.

About National Council for Applied and Economic Research (NCAER):

Established in **1956, NCAER** is **India's oldest and largest independent, non-profit, economic policy research institute.** It is one of a handful of think tanks globally that combine rigorous analysis and policy outreach with deep data collection capabilities, especially for household surveys.

Environment

Tribal leader Rajappa to receive award for welfare, forest conservation work

Sub : Env

Sec: biodiversity

Context:

- The **Hulikanu Wildlife Conservancy Foundation (HWCF)** in **Bengaluru** has nominated **J.T. Rajappa**, a tribal conservationist and community leader, for the prestigious **Hulikanu Progressive Adivasi Wildlife Award**.
- The award includes a **₹3 lakh cash prize**.

Hulikanu Wildlife Conservancy Foundation (HWCF):

- It is a Private incorporated on 03 February 2014.
- It is classified as **Non-government company** and is registered at the **Registrar of Companies,** ROC Bangalore.

About J.T. Rajappa:

- Born in **1965** into the **Jenu Kuruba tribe, Rajappa** grew up in the **Malalu Kolli Hadi hamlet** near **Nagarahole, Karnataka.**
- He developed a strong passion for wildlife and conservation from an early age.
- He worked as a **Forest Department watcher (1984-1987),** where he became aware of the hardships faced by his community.
- Elected to the **Virajpet taluk panchayat** in **2005**, **Rajappa** began driving **positive change** for **forest-dwelling communities.**
- Since 2007, he has been instrumental in the **voluntary resettlement of over 300 tribal families** to modern communities outside the Nagarahole Tiger Reserve.

Key Achievements:

- **2010**: Led the relocation of 150 families to Settahalli in Hansur taluk.
- Served on influential committees:
  - **National Tiger Conservation Authority (NTCA)** (2012-2015).
  - **Mysore District Relocation Committee** (post-2015), where he pushed for the integration of social development with wildlife conservation.

Jenu Kuruba tribe:

- The **Jenu Kuruba** are a tribe of people who traditionally gathered **honey** and lived in the forests of the **Western Ghats in India.**
- The word **"Jenu"** means **"honey"** in **Kannada,** reflecting the tribe's traditional occupation.
- The **Jenu Kuruba** are primarily found in the **Nilgiris region**, which borders **Karnataka and Kerala.**

Indigenous Amazon activist in Columbia takes his fight to the UN biodiversity forum

Sub : Env

Sec: Biodiversity

Context:

- **Ecuadoran** activist **Alex Lucitante**, a determined defender of the **Amazon rainforest**, continues his fight against **land-grabbing miners** and **armed groups** threatening his homeland. Later this month, Lucitante will represent **Indigenous communities** at the **COP-16 biodiversity conference** in **Cali, Colombia,** where he aims to amplify the voices of his people on the global stage.

Key Points:

- Alex Lucitante, 31, belongs to the '**Cofan Avie ethnic group'** and is the son of a shaman.
- He has led efforts to combat **illegal gold mining** in the **Amazon,** establishing an Indigenous guard and a **drone surveillance system** to protect his community's lands.
- In **2018,** Lucitante and his community won a major legal case that resulted in the **annulment of 52 gold mining concessions** in **Ecuador**, which were granted without community consultation.
- In **2022,** Lucitante and fellow activist **Alexandra Narvaez** received the **Goldman Prize**, often considered the **"Nobel"** for environmentalists, for their work protecting the Amazon.
  - Each year, the **Goldman Environmental Prize** is awarded to **grassroots environmental champions** from around the world.
- Despite legal and grassroots victories, **illegal gold mining** continues in the Amazon, devastating local ecosystems.

Cofan Avie ethnic group:

- The **Cofán**, who call themselves **A'i,** are an **Indigenous people** living in **Sucumbíos Province in northeast Ecuador, Southern Colombia,** and between the **Guamués and Aguarico Rivers.**

- They speak **A'ingae (Cofán language)**

Global wildlife numbers have declined 73% since 1970, says WWF

Sub : Env

Sec: Biodiversity

Context:

- The **World Wide Fund (WWF) for Nature's Living Planet Report (LPR) 2024** highlights a **73% decline** in monitored wildlife populations from **1970** to **2020**, up from a **69% decline** in the **2022 edition**.
- The report emphasises the need for significant **"collective effort"** over the next **five years** to address the dual crises of **climate change** and **biodiversity loss.**

Details:

- **Living Planet Index (LPI)**, provided by the **Zoological Society of London (ZSL)**, tracks **35,000 population trends** across **5,495 species** from **1970-2020:**
    - Freshwater ecosystems show the steepest **decline** at 85%.
    - Terrestrial ecosystems face a 69% **decline**.
    - Marine ecosystems have a 56% **decline**.
- **LPI** in **2024** and **2022 reports** are not directly comparable due to changes in datasets (265 additional species, 3,015 more populations added in 2024).
- Wildlife declines signal potential extinction risks and vulnerability of ecosystems to tipping points, which could lead to irreversible changes.

Key Threats to Wildlife:

- **Habitat loss** and **degradation**, driven by unsustainable farming and food consumption.
- Over-exploitation, invasive species, and diseases.
- Pollution, especially in Asia and the Pacific, which has seen a **60% decline** in **wildlife populations.**

India's Wildlife Recovery:

- While many populations have **declined**, **India** has seen some success due to government initiatives, habitat management, and community engagement.
- **India** hosts the **largest wild tiger population,** with a minimum of **3,682 tigers** recorded in **2022**, up from **2,967** in **2018**.
- The **Ministry of Environment, Forest & Climate Change (MoEF&CC)** recently launched the **first Snow Leopard Population Assessment in India (SPAI),** which systematically evaluated **70%** of their potential range.
- This assessment estimated the **snow leopard population** at **718.**

Vulture Decline in India:

- Three species — **white-rumped vulture, Indian vulture,** and **slender-billed vulture** — show **significant declines** (67%, 48%, and 89%, respectively, since 2002).
- Conservation efforts are urgently needed to protect these scavengers and maintain ecological balance.

Global Perspective:

- Nature is under severe stress due to linked crises of biodiversity loss and climate change, threatening critical ecosystems like the Amazon rainforest and coral reefs.
- Countries have pledged to halt nature loss (Global Biodiversity Framework), limit global warming to **1.5°C** (Paris Agreement), and eradicate poverty (UN Sustainable Development Goals).
- However, current national actions are insufficient to meet 2030 targets and avoid catastrophic tipping points.

About WWF:

- **WWF** is an independent conservation organization, with over **30 million** supporters and a global network active in over 100 countries.
- **WWF's mission** is to stop the degradation of the **Earth's natural environment** and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

About ZSL:

- Founded in **1826**, **ZSL** is an international conservation charity, driven by science, working to restore wildlife in **the UK** and around the world; by protecting critical species, restoring ecosystems, helping people and wildlife live together and inspiring support for nature.

- Through our leading conservation zoos, **London** and **Whipsnade,** we bring people closer to nature and use our expertise to protect wildlife today, while inspiring a lifelong love of animals in the conservationists of tomorrow.

2024 Global Nature Conservation Index: India ranked 176 out of 180 countries, labelled among worst performers

<u>Sub: Env</u>

<u>Sec: Biodiversity</u>

Global Nature Conservation Index (NCI) 2024:

- **India** ranks **176th out of 180 countries** in the **first-ever Nature Conservation Index (NCI),** with a score of **45.5/100,** marking it as **one of the five lowest performers** alongside **Kiribati, Turkey, Iraq,** and **Micronesia.**
- The **NCI,** launched in **October 2024**, was developed by the **Goldman Sonnenfeldt School of Sustainability and Climate Change (Ben-Gurion University)** and **BioDB.com.**
- It assesses conservation efforts across **four main areas:**
1. land management,
2. biodiversity threats,
3. governance, and
4. future trends.

India's Key Challenges:

- **Land Management**: India faces a **high rate of land conversion (53%)** for urban, industrial, and agricultural use. There is **heavy pesticide usage,** and **soil health is at risk,** as indicated by **a sustainable nitrogen index of 0.77.**
- **Marine Conservation**: **Only 0.2% of India's national waterways** are protected, and none within its **Exclusive Economic Zone (EEZ)**, although **7.5%** of terrestrial land is protected.
- **Habitat Loss**: Significant habitat loss and fragmentation result from agriculture, urbanization, and infrastructure. Between **2001-2019, India lost 23,300 sq. km** of tree cover.
- **Biodiversity Decline**: While **40%** of **marine species** and **65%** of **terrestrial species** live in **Protected Areas,** population declines are substantial, affecting **67.5%** of **marine** and **46.9%** of **terrestrial species.**
- **India** struggles with **SDG 14 (Life below water)** and **SDG 15 (Life on land)**, highlighting the need for better marine and terrestrial biodiversity protection.

Future Trends and Concerns:

- The report underscores **India's high population density, urban sprawl,** and **threats to its biodiversity** and **ecological balance.**
- **India's illegal wildlife trade** ranks as the **fourth-largest globally,** valued at around **£15 billion annually.**

Path Forward:

- To improve its conservation status, **India** must enhance political commitment, enforce stricter environmental laws, and secure funding for conservation projects.
- The **NCI** is optimistic, suggesting that with strategic political action and investment, India can address these challenges and work toward a sustainable, ecologically sound future.

More than one in three tree species threatened with extinction, finds IUCN's first Global Tree Assessment

Sub: Env

Sec: Biodiversity

Global Tree Assessment:

- The first-ever **Global Tree Assessment**, launched by the **International Union for Conservation of Nature (IUCN)** at **COP16** of the **Convention on Biological Diversity** in **Cali, Colombia**, has revealed a critical threat to global biodiversity: nearly **38% of tree species worldwide are now at risk of extinction**.

Key Findings:

- **Extent of Threat**: **16,425** out of **47,282** assessed tree species face the risk of **extinction**, meaning over **one in three species** could be lost.
- The number of threatened tree species surpasses the total of threatened birds, mammals, reptiles, and amphibians combined.
- Trees are endangered in **192 countries**, with islands particularly vulnerable due to urban development, agriculture, and invasive species.

Causes of Decline:

- **Deforestation and Land Use**: **South America,** with the **highest tree diversity**, has **3,356 tree species at risk**, mainly due to deforestation for agriculture and livestock.
- **Climate Change**: Rising sea levels, storms, and other extreme events increasingly threaten trees, especially in tropical regions.
- **Dependence on Trees**: Over **5,000 tree species** on the **IUCN Red List** are used for timber, and **2,000** for food, fuel, and medicine, underscoring the risk to essential resources.

Importance of Trees:
- **Ecosystem Role**: Trees are vital for carbon and water cycles, soil formation, and climate regulation, supporting a wide range of other plants, fungi, and animals.
- **Forest-Dependent Species**: Many globally threatened birds and other wildlife rely on forests, heightening the interconnected risk from tree loss.

How high-performance buildings are the next step towards a sustainable future

Sub : Env

Sec: Climate Change

Importance of Energy Efficiency in Buildings:
- **Buildings and Emissions**: Globally, buildings are responsible for about **40%** of total final energy consumption, primarily due to operational needs like **Heating, Ventilation, and Air Conditioning (HVAC) systems** and lighting.
  - **Emissions Impact**: This accounts for **28%** of energy-related carbon emissions, both from on-site energy use and off-site sources like power plants.
  - In **India**, buildings contribute to **more than 30%** of **national energy use** and **20%** of its **carbon emissions (Bureau of Energy Efficiency).**
- **Urbanization Challenge**: As India's urban population is expected to reach **600 million by 2030**, unchecked building practices could significantly increase the sector's **carbon footprint,** surpassing global benchmarks for energy efficiency and emissions.

High-Performance Buildings (HPBs) vs Green Buildings:
- **Green Buildings**: Focus on reducing environmental impact, energy use, and water conservation, often achieving certification through established programs.
- **High-Performance Buildings (HPBs)**:
  - Aim for **peak efficiency** in **energy, water use,** and **occupant comfort,** going beyond basic requirements.
  - **Features**:
    - Advanced technologies such as **energy-efficient HVAC systems, greywater recycling**, and **smart lighting.**
    - Real-time performance tracking using a **Building Management System (BMS)** for resource optimization.
    - Site-specific designs incorporating natural lighting, ventilation, and terrain water management.
    - Use of sustainable materials like **low U-value windows** to enhance thermal efficiency.
  - **Examples in India**:
    - **Unnati** in Greater Noida: Incorporates high-performance glass and façade design for energy efficiency.
    - **Indira Paryavaran Bhawan** in New Delhi: Uses a cutting-edge HVAC system that reduces energy consumption through natural convection.
- These building designs have paved the way for **net-zero buildings** (structures that generate as much energy and water as they consume) and **grid-interactive buildings**.

Benefits of HPBs:
- **Operational Efficiency**: Smart systems in HPBs extend the lifespan of building systems and reduce the need for frequent upgrades.
  - **Example**: The **Infosys campus** in **Bengaluru** uses a **BMS** to monitor and adjust building performance, lowering maintenance costs.
- **Higher ROI**: HPBs generally provide better returns through higher property values and lower operational costs.
- **Technological Integration**: Automation and **AI** in **HPBs** can create **intelligent ecosystems**, where systems adjust lighting, temperature, and ventilation based on real-time data like occupancy or weather.
- **Health and Comfort**: These buildings prioritize occupant well-being with better air quality, natural lighting, and thermal comfort.

HPBs and India's Urban Challenges:

- **Resilience**: HPBs can withstand **resource scarcity, energy market fluctuations,** and **rising temperatures.**
  - o **TCS Banyan Park** in **Mumbai** is an example of integrating green spaces and natural lighting to create a sustainable, energy-efficient environment.
- **Infrastructure Pressure**: As India urbanizes, HPBs offer a proactive solution by positioning buildings as drivers of sustainable growth, easing the burden on public infrastructure, and contributing to a **low-carbon economy**.

As green patch spreads in Antarctica, here's what is worrying scientists
Sub: Env

Sec: Climate change

Context:

- Plant cover on the **Antarctic Peninsula,** a mountainous extension of Antarctica, has **increased more than 10 times** in recent decades due to **rising temperatures.**
- The study, *Sustained greening of the Antarctic Peninsula observed from satellites*, published in *Nature Geoscience*, shows a dramatic transformation.

How Fast is Antarctica Warming?

- **Warming Rate**:
  - o **Antarctica** is **warming twice** as fast as the **global average** (0.22-0.32°C per decade).
  - o The **Antarctic Peninsula** is warming **five times faster** than the global average.
  - o Since **1950,** the **Antarctic Peninsula** has warmed by almost **3°C**.
- **Record Heat**:
  - o The continent has experienced **record-breaking heatwaves**, particularly during its **winter** (northern hemisphere summer).
  - o In July 2024, ground temperatures were **10°C higher** than normal and up to **28°C higher** on certain days.
  - o In **March 2022, East Antarctica** experienced an **extreme heatwave** with temperatures **39°C above normal**.

Key Findings of the Study

- **Vegetation Growth**:
  - o Satellite data shows a **14-fold increase** in **vegetation** on the **Antarctic Peninsula** between **1986** and **2021.**
  - o Plant cover (mainly mosses and lichens) expanded from **less than 1 sq km to almost 12 sq km** in **35 years.**
  - o The rate of greening has accelerated by more than **30% between 2016 and 2021**.
  - o Researchers attribute this rapid transformation to **anthropogenic climate change**.
- **Sea Ice Reduction**:
  - o The extent of sea ice is rapidly **decreasing**. In **2024,** it was the **second smallest** on record, only slightly higher than the record low in **2023.**
  - o **Warmer open seas** are likely creating wetter conditions that support plant growth.

Concerns About Increased Vegetation in Antarctica:

- **Invasive Species Risk**:
  - o **Mosses** can create **soils,** making the continent more vulnerable to **invasive species,** which could threaten **native flora and fauna.**
  - o Human visitors (eco-tourists, scientists) could unintentionally introduce **non-native species.**
- **Impact on Sunlight Reflection**:
  - o Increased plant cover could **reduce Antarctica's ability to reflect sunlight** (albedo effect), leading to more heat absorption and further warming.
- **Ice Loss and Sea Level Rise**:
  - o Antarctica has lost **280% more ice** in the **2000s** and **2010s** compared to the **1980s** and **1990s.**
  - o Rising temperatures will **accelerate ice loss,** contributing to global sea level rise.
- **Future Outlook**:
  - o As greenhouse gases continue to accumulate in the atmosphere, warming will persist, and **vegetation in Antarctica** is expected to **increase** further.

Climate change threatens to alter methane emissions in the Amazon, study reveals

Sub: Env

Sec: Climate change

Context:

- New research from the **University of São Paulo** highlights **how climate change could disrupt greenhouse gas dynamics in the Amazon rainforest,** with significant global consequences.
- The study reveals contrasting changes in **methane emissions** and uptake in the **Amazon's floodplain** and **upland forest soils,** driven by **rising temperatures** and **increased flooding.**

Key Findings:

- **Amazon's Role in Methane Regulation**: The **Amazon** plays a crucial role in **global methane levels,** acting as both a **source and sink** for this potent greenhouse gas.
- **Floodplains and Upland Forests**:
  - **Floodplains** (covering **800,000 square kilometers** during the rainy season) contribute up to **29% of global wetland methane emissions.** In these waterlogged areas, **methane-producing microbes thrive.**
  - **Upland Forests**, usually **methane sinks,** are highly vulnerable to changes in temperature and humidity. **Methane uptake** in upland forests **dropped by 70%** in warmer, drier conditions.
- **Research Method**:
  - **Soil samples** from both floodplains and upland forests were exposed to temperatures of **27°C** and **30°C**, with **varying humidity levels,** over 30 days.
  - Results showed that while **methane emissions** in floodplains remained stable, **methane-producing microbes increased.**
  - In **upland forests**, the number of **bacteria** and **archaea** (organisms responsible for methane cycling) **declined**, showing their sensitivity to warming.

Methane Cycling and Microbial Activity:

- **Methanotrophic Microorganisms** (those that **consume methane**) were active in both **aerobic** and **anaerobic conditions** in **floodplains**, showing adaptability to **climate change.**
- In contrast, upland forest microbes are **less resilient,** which could disrupt the balance of methane emissions in the Amazon.

Implications:

- **Global Impact**: The **Amazon's shift in methane dynamics** could significantly **worsen global greenhouse gas concentrations,** as the region's role in both emitting and absorbing methane is crucial for global climate regulation.
- **Climate Change Sensitivity**: The **Amazon's upland forest ecosystems** are particularly fragile, raising concerns about increased methane emissions as climate conditions change.

About Methane:

- It is the **primary component of natural gas,** and is responsible for approximately a **third of the warming** we are experiencing today.
- **Characteristics:**
  - It is a **colorless odorless gas, flammable water insoluble gas.**
  - It is also known as **marsh gas** or **methyl hydride.**
  - It is easily **ignited**. The vapours are lighter than air. Under prolonged exposure to fire or intense heat, the containers may rupture violently and rocket.
  - It is a **powerful** and **short-lived greenhouse gas,** with a **lifetime of about a decade** and a **Global Warming Potential about 80 times greater than that of carbon dioxide (CO2)** during the 20 years after it is released into the atmosphere.

Where does methane come from?

- It sometimes comes from **non-human sources** like **wetlands.** These habitats contain things like **permafrost,** which is frozen ground that's also filled with **carbon** from animals and plants that have been dead for hundreds of thousands of years.
- As **temperatures rise** with **global warming**, **wetland permafrost thaws**. That **unleashes carbon,** previously locked in the ice, in the form of **CO2** and **methane.**
- Around **60%** of the **methane** that makes it into the atmosphere comes from **human activities.**

Oceans on the Brink: Challenges in Meeting the 30% Protection Target by 2030

Sub :Env

Sec: Climate change

Why in News

At the **United Nations Biodiversity Conference (COP15)** in 2022, world leaders pledged to protect **30% of the Earth's oceans by 2030**. However, the latest reports reveal that despite oceans covering over **70% of the planet**, only **2.8%** are effectively protected, far short of the target. This raise concerns over ocean conservation efforts, which are crucial for mitigating climate change, overfishing, and pollution.

Commitment at COP15

At the COP15, a bold commitment was made to protect **30% of the oceans by 2030**. Address the rising threats from **climate change**, **overfishing**, and **pollution**.

Current Protection Status: Only **2.8%** of oceans are effectively protected despite covering over **70% of the planet**.

Oceans play a critical role in **carbon absorption** and **climate regulation**, yet most remain unprotected or weakly regulated.

About COP15:

COP15 was the United Nations Biodiversity Conference held in **2022**.

The conference led to the adoption of the **Kunming-Montreal Global Biodiversity Framework**.

COP15's **30x30 target** aims to protect **30% of Earth's land and oceans by 2030**.

Developed nations committed to providing **$20 billion annually by 2025** and **$30 billion by 2030** to support biodiversity efforts in developing countries.

The framework emphasizes reducing **plastic and chemical pollution** to protect ecosystems.

COP15 promoted the ratification of the **High Seas Treaty** for the protection of international waters.

The **sustainable use of biodiversity** was a core focus, ensuring ecosystem services for local and indigenous communities.

Assessment of Progress Toward the 30x30 Target

The report titled **"On Track or Off Course? Assessing Progress Toward the 30x30 Target in the Ocean"** reveals a significant gap between pledges and actual protection. **8.3%** of oceans are designated as **Marine Protected Areas (MPAs)**, yet many MPAs permit harmful activities like **industrial fishing**, **oil extraction**, and **dumping**.

About 30X30 target-

The foundation of the GBF agreement is a **pledge to protect 30% of the world's land and oceans by 2030,** usually referred to as the **30X30 goal.**

The **30X30 target** was first floated in **2019** in an **article A Global Deal for Nature: Guiding principles, milestones, and targets published in Science Advances.**

This then became the global call of the **High Ambition Coalition for Nature and People** in 2020 and as of October 2022, more than **100 countries** are part of it.

Countries have to commit to protecting **30 per cent** of the land and sea by **2030** under this goal.

Blue Washing: A Growing Concern

Blue washing refers to **the practice of labeling areas, companies, or activities as environmentally friendly** or sustainable, **especially related to ocean conservation,** without implementing effective measures to protect marine ecosystems.

It often involves **misleading claims about marine protection efforts,** where governments or organizations declare areas as **Marine Protected Areas (MPAs)** but allow **harmful activities** like industrial fishing, oil drilling, or pollution to continue.

It can be **used interchangeably with the term greenwashing** but has a greater focus on economic and community factors. Alternatively, it could be phrased as a way that **companies hide the social damage that their policies have caused**.

Active disinformation is a tool that companies use **to make their goods or services more attractive to their consumers and shareholders**.

Five-Point Agenda for Achieving the 30x30 Target

Expand Marine Protected Areas (MPAs): **Panama's Banco Volcán MPA** expanded from **14,000 km²** to over **90,000 km²**, now protecting almost **50%** of the country's seascape.

Ensure Effective Management of Existing MPAs: The **UK's Blue Belt Programme** showcases how targeted management can enhance marine environments.

Integrate Indigenous Knowledge in Conservation: Indigenous conservation efforts, such as **Inhambane Bay Community Network** in **Mozambique** and **Gitdisdzu Lugyeks MPA** in **Canada**, show how traditional knowledge can improve marine protection.

Provide Financial Support and Capacity Building: Developed countries must fulfill their commitment to provide at least **$20 billion annually** by **2025** and **$30 billion** by **2030** to support developing nations.

Improve Reporting and Data Collection: Better tracking and transparent reporting of marine conservation efforts are essential for progress.

Countries Leading in Marine Protection

Monaco (100%), **Palau (99%)**, **UK (68%)**, and **Kazakhstan (52%)** have designated more than **30%** of their waters as MPAs.

However, only **Palau (78%)** and the **UK (39%)** have been assessed as effectively protecting more than 30% of their waters.

Company uses mining dust to enhance carbon capture

Sub: Env

SEC: Climate Change

Context:

- **Alt Carbon,** a **Darjeeling-based company,** is pioneering a surprising **climate-friendly solution** using dust from mining and has already secured **$500,000** in investments from **carbon-credit companies.** The company's approach is based on the **geo-chemical process** called **rock weathering**, which accelerates **natural carbon sequestration**.

Details:

- Over thousands of years, **rocks** break down into **minerals** due to exposure to **rain** and **heat. Atmospheric carbon** reacts with minerals like **calcium** and **magnesium,** forming **bicarbonates.** These **bicarbonates** are carried by **underground streams** into the **oceans**, where **carbon is stored for millennia.**

- Oceans act as major **carbon sinks**, capturing about **30%** of CO_2 from human activities.

- As **carbon dioxide levels rise, natural rock weathering** is too slow to mitigate climate change.

- Governments and businesses are experimenting with ways to **accelerate** carbon removal, including **enhanced rock weathering**.

What is Enhanced Rock Weathering (ERW)?

- **Enhanced rock weathering (ERW)** is a **nature-based process** that **accelerates** the **natural weathering of rocks** to **remove carbon dioxide** from the atmosphere and help address climate change:

- **How it works?**

- **ERW** involves spreading **finely ground silicate rocks,** like **basalt,** on land. This increases the surface area of the rock, which speeds up the chemical reactions between the rocks, water, and air.

- **Benefits:**
    o **Carbon sequestration:** ERW can help remove carbon dioxide from the atmosphere.
    o **Improved soil:** ERW can improve soil pH, nutrient uptake, and fertility.
    o **Reduced ocean acidification:** ERW can help mitigate ocean acidification.

- **Challenges**
    o High energy requirements
    o Elevated levels of heavy metals
    o Limited availability of suitable rocks
    o Logistics of transportation
    o Cost of rock crushing

How Alt Carbon Accelerates Carbon Capture?

- Rich in minerals like **calcium** and **magnesium**, **basaltic rock** is abundant in areas such as **Maharashtra, Gujarat, Jharkhand,** and **West Bengal**.

- When basaltic rock is crushed into **fine powder,** its **surface area increases significantly,** speeding up the **conversion of carbon into bicarbonates.**

- **Operational Process**:
    o **Alt Carbon** collects tonnes of crushed **basalt** from the **Rajmahal mines.**
    o The dust is transported **200 km** to **Darjeeling** and **spread on tea estates, enriching the soil** while **sequestering carbon.**
    o The **basalt dust** acts as an **organic fertiliser** and helps capture carbon **10 to 100 times faster** than **natural weathering.**

Results and Carbon Credits:

- **Carbon Sequestration Efficiency**:
    o It takes **3-4 tonnes** of **basalt dust** to sequester **1 tonne of carbon over 2-4 years**, compared to **1,000 years** for natural basalt.

- o So far, **Alt Carbon** has used **500 tonnes of basalt dust.**
- **Carbon Credit Agreements**:
  - o Each tonne of carbon sequestered counts as one **carbon credit**.
  - o In September, **Alt Carbon** entered an agreement with **Frontier** (consisting of **McKinsey, Alphabet, Meta, Shopify,** and **Stripe**) for **$500,000** to buy carbon credits in advance.
  - o Another agreement was signed with **NextGen**, which buys carbon credits at **$200** per tonne.

Challenges and Future Plans:
- While **enhanced rock weathering** is promising, there are concerns about the **accuracy of measuring sequestered carbon** across different projects.
- Studies show variations in sequestration, with some projects claiming **100 tonnes** and others **up to 1,000,000 tonnes** for similar efforts.
- The company **aims** to sequester **50,000 tonnes of carbon** in the next few years.
- To address measurement challenges, Dr Sambuddha Misra (Chief Scientist at Alt Carbon) has set up lab facilities and developed a protocol called **FELUDA** to standardize measurements, which can be used by other companies.

How policies shape high-performance building standards and climate goals
Sub: Env

Sec: Climate

High-performance buildings (HPBs):
- **High-performance buildings (HPBs)** are emerging as vital solutions in addressing both **urban and climate-related challenges** within the **construction sector.**
- These buildings are designed to **reduce greenhouse gas emissions, minimize energy and water consumption,** and **cut operational costs** while improving **occupant well-being.**
- They are becoming increasingly attractive to businesses and residents alike due to their environmental and financial advantages

Key Features of HPBs:
- **Climate-Adaptive Design:** Reduces energy use and operational costs.
- **Environmental Impact:** Lowers greenhouse gas emissions.
- **Well-Being:** Enhances the comfort and health of occupants.
- **Financial Benefits:** Offers higher property value, reduced utility bills, and access to carbon financing.

Global Support for HPBs:
- Governments around the world are creating policies and financing mechanisms to promote **HPBs** by focusing on **energy efficiency, resource management,** and **carbon neutrality.**
- **Examples of International Policies:**
- **European Union:** The **Green Deal** targets **climate neutrality by 2050** and mandates **energy-efficient building designs and retrofits**.
- **Germany:** KfW Bank offers **low-interest loans** for **energy-efficient projects.**
- **Denmark: BR18 building codes** incentivize sustainable construction.
- **United States: Programs** like **Energy Star** and **LEED certification** provide **tax credits** for **green-building initiatives.**

India's Role in Supporting HPBs:
- **India** is actively promoting **energy-efficient buildings** through its **National Action Plan on Climate Change**. The **Bureau of Energy Efficiency (BEE)** has developed the **Energy Conservation Building Code (ECBC)**, which **aims** to reduce energy demand by up to **30%.** Other initiatives include:
  - o **Green Rating for Integrated Habitat Assessment (GRIHA):** Over **3,000** registered projects focusing on sustainability.
  - o **Indian Green Building Council (IGBC):** Promotes energy-efficient designs with more than **14,000** certified projects.
  - o **Incentives:** Cities like **Hyderabad, Noida,** and **Pune** offer higher floor area ratios for **ECBC-compliant buildings.**
- **BEE** aims for **30%** of new buildings to achieve **net-zero energy** status by **2030**.

Financial Advantages of HPBs:

- As the **cost of green technologies drops,** the price gap between **conventional and high-performance buildings is closing.**
- **Key financial benefits include:**
  - **Energy Savings:** HPBs offer significant reductions in energy consumption, like Infosys' energy-efficient campuses that cut energy use by 45%.
  - **Property Value:** HPBs command higher property values due to lower operational costs, environmental benefits, and growing demand from eco-conscious buyers.
  - **Investment Appeal:** HPBs lead to higher net operating incomes, lower vacancy rates, and longer leases, making them attractive to investors.

Financing HPBs:
- **HPBs** can leverage various funding sources, including:
  - **Carbon Financing: HPBs** can generate **carbon credits** by **reducing emissions**, which can be **traded** for **financial gain** in regions with **carbon pricing** (e.g., the EU and China).
  - **Green Bonds:** In **2020, green bonds worth $269.5 billion** were issued globally, helping to finance sustainable building projects.
  - **Climate Funds:** Institutions like the **World Bank** and the **Green Climate Fund** provide financial support for **HPBs.**
- These mechanisms offset the higher upfront costs of constructing **HPBs,** making them more affordable and promoting wider adoption.

Catastrophic warming is still on the cards
Sub : Env

Sec :Climate change

Context:
- The **United Nations** warns that current national efforts to reduce greenhouse gas emissions are insufficient to prevent **catastrophic global warming.**

Current Emissions Targets:
- **Insufficient Reductions**: **Nationally determined contributions (NDCs)** submitted by countries **aim** for only a **2.6% emissions cut** from **2019 levels** by **2030.** Scientists say a **43% reduction** is necessary to **limit global warming to 1.5°C,** per the **Paris Agreement.**

Rising Greenhouse Gas Levels:
- **Record Highs**: The **World Meteorological Organization (WMO)** reported $CO2$ concentrations reached **420 ppm** last year, rising by **11.4%** over two decades.
- **Worrying Trends**: Feedback loops, like increased forest fires, are accelerating greenhouse gas levels. **Carbon** released from Canada's recent record wildfire season alone surpassed annual emissions of many major countries.

Nationally Determined Contributions (NDCs):
- **NDCs** are **national climate action plans** that countries submit under the **Paris Agreement** to reduce greenhouse gas emissions and adapt to climate impacts.
- **Requirements:**
  - Must be submitted every 5 years
  - Should be progressively more ambitious
  - Must outline domestic mitigation measures

India's NDCs:
1. **Updated NDCs (2022):**
   - Reduce emissions intensity of **GDP by 45%** by **2030** from **2005 levels**
   - Achieve about **50%** cumulative electric power installed capacity from non-fossil fuel sources by **2030**
   - Create additional carbon sink of **5 to 3 billion tonnes of $CO2$ equivalent** through forest and tree cover by **2030**
2. **Key Implementation Strategies:**
   - Promoting renewable energy (solar, wind, hydro)
   - Improving energy efficiency
   - Developing climate-resilient urban centers
   - Enhanced forest conservation
   - Sustainable transportation systems

- o Waste management initiatives
3. **Major Programs Supporting NDCs:**
   - o National Solar Mission
   - o National Smart Grid Mission
   - o National Electric Mobility Mission Plan
   - o Green India Mission
   - o Energy Conservation Building Code
4. **Progress and Achievements:**
   - o Already achieved **40%** power capacity from **non-fossil sources** ahead of **2030** target
   - o Significant expansion in renewable energy capacity
   - o Implementation of energy efficiency programs
   - o Progress in afforestation efforts
5. **Challenges:**
   - o Financial resource mobilization
   - o Technology transfer needs
   - o Capacity building requirements
   - o Balancing development with environmental goals
   - o Infrastructure development needs
6. **International Support:**
   - o Climate finance requirements
   - o Technology transfer mechanisms
   - o Capacity building assistance
   - o International cooperation frameworks

Carbon sink broken? Last year, trees and land barely absorbed any CO2

Sub : Env

Sec: Climate change

Context:

- A recent study shows that **critical natural processes** that help **cool the Earth** are weakening. In **2023**, **trees and land absorbed almost no carbon dioxide (CO_2).**
- The **absorption of CO_2 by trees** and **zooplankton feeding on algae** (which removes millions of tonnes of CO_2 annually) are key cooling processes.

Key Findings of the Study:

- The study, titled *Low latency carbon budget analysis reveals a large decline of the land carbon sink in 2023,* reported a **CO_2 growth rate of 3.37 ± 0.11 PPM** at **Mauna Loa, Hawaii,** an **86% increase** from the previous year.
- This growth rate is the **highest recorded** since measurements began in **1958**, indicating a significant weakening of **land and ocean CO_2 sinks**.

Wildfires and Land Sink Collapse:

- The study noted that **global CO_2 emissions rose only $0.6 \pm 0.5\%$ in 2023.**
- The **2023 northern hemisphere wildfires** are believed to have played a role in the land sink's sharp decline.

Long-term Implications:

- Although current data suggests an unprecedented weakening, researchers advise caution in concluding that this collapse will continue regularly.

Supreme Court Criticizes Delhi Government Over Neglect of Capital's Green Cover

Sub :Env

Sec: Ecosystem

Why in News

The **Supreme Court reprimanded the Delhi government's Forest Department for its lack of action in improving the city's green cover.** This rebuke comes after the department failed to submit a report detailing comprehensive steps taken to **enhance the capital's greenery,** which the court had previously requested over three months ago.

What is Green Cover?

Green cover refers to all vegetation, **including trees, forests, grasslands, wetlands, and farmlands,** that contributes to the **greening of an area.** It includes natural forests, man-made forests (plantations), and other vegetation that helps maintain ecological balance and provide various environmental benefits.

Components of Green Cover

Forest Cover: This includes **natural forests and plantations with a canopy density above 10%.**

Tree Cover: Refers to **trees growing outside forests,** including urban trees, farmland, and roadside plantations.

Grasslands and Shrubs: Vegetation that contributes to **ecological balance** but doesn't qualify as forest cover.

Importance of Green Cover

Carbon sequestration to mitigate climate change.

Improving air quality by absorbing pollutants.

Regulating the water cycle and preventing soil erosion.

As of 2023-2024, **Delhi's green cover** stands at around **23.06%** of its total geographical area, with various efforts being made to increase this figure.

On a national scale, India's overall forest and tree cover increased to **24.62%** of its total land area, according to the 2021 report by the Forest Survey of India. The country has been working toward achieving the national goal of **33% green cover**.

Supreme Court's Reprimand

The Supreme Court, criticized the Forest Department for showing a "complete lack of interest" and a "lacklustre" approach in increasing Delhi's green cover. **Despite directions issued in June 2024, the Forest Department had not yet provided a plan or steps to enhance the green cover in the city.**

Constitutional Provisions Related to Forest Conservation:

Article 48-A: Directs the state to protect and **improve the environment and safeguard forests and wildlife.**

Article 51-A(g): Lays down the **duty of every citizen of India to protect and improve the natural environment, including forests.**
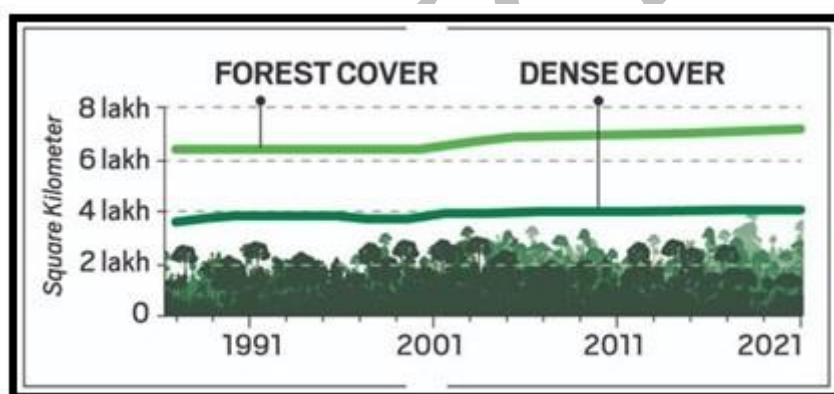
India State of Forest Report

It is an **assessment of India's forest and tree cover**, published **every two years** by the Forest Survey of India under the Ministry of Environment, Forests and Climate Change.

The **first survey was published in 1987**, and ISFR 2021 is the 17th.

India is one of the few countries in the world that brings out such every two years, and this is widely considered comprehensive and robust.

With data computed through wall-to-wall mapping of India's forest cover through remote sensing techniques, the ISFR is **used in planning and formulation of policies** in forest management **as well as forestry and agroforestry sectors**.

Forest Cover is defined as "An area more than 1 ha in extent and **having tree canopy density of 10 percent and above**".

Tree Cover is defined as "**Tree patches outside recorded forest areas exclusive of forest cover** and less than the minimum mappable area of one hectare".

Three categories of forests are surveyed

Very Dense Forests (canopy density over 70%),

Moderately Dense Forests (40-70%) and Open Forests (10-40%),

Scrubs (canopy density less than 10%)

Phytoplankton Balloon to Six Times Their Size to Navigate Ocean Depths

Sub :Env

SEC: Ecosystem

Why in News

A recent discovery has shed light on how **single-celled phytoplankton**—specifically the bioluminescent species **Pyrocystis noctiluca**—can inflate to six times their original size to reach the ocean's surface. This phenomenon helps explain the long-standing mystery of how these organisms, without appendages, rise to the surface to photosynthesize before sinking back into the ocean depths.

About Pyrocystis noctiluca:

Pyrocystis noctiluca is a species of **bioluminescent phytoplankton** found in oceans.

A recent study published in the journal **Current Biology** reveals that the **bioluminescent phytoplankton Pyrocystis noctiluca** can **inflate up to six times their original size**, enabling them to float to the surface and escape the downward pull of gravity.

Researchers liken this behavior to **mini-submarines** that can adjust their density, allowing the phytoplankton to move up or down in the water column at will.

How Inflation occurs: The inflation occurs as part of the **phytoplankton's cell cycle**. When a phytoplankton cell divides into two daughter cells, a structure called a **vacuole** fills with **freshwater**, causing the cells to expand.

This process reduces the cells' density, allowing them to rise toward the ocean surface, where they can photosynthesize and gather sunlight.

The inflation is part of its **cell cycle**, occurring after cell division. The organism is **5%-10% heavier than seawater**, making buoyancy control essential for survival.

It plays a key role in marine ecosystems as part of the **food chain** and **carbon cycle**. This species contributes to **carbon sequestration** by absorbing CO_2 from the atmosphere.

About Phytoplankton:

Phytoplankton are the **autotrophic (self-feeding)** components of the plankton community and a key part of ocean and freshwater ecosystems.

Phytoplankton are microscopic, **single-celled organisms** that inhabit the surface of oceans, where they play a critical role in the global ecosystem by **photosynthesizing** sunlight.

Phytoplankton **obtain their energy through photosynthesis**, as do trees and other plants on land. This means **phytoplankton must have light from the** sun, so they live in the well-lit surface layers (euphotic zone) of oceans and lakes.

In comparison with terrestrial plants, **phytoplankton are distributed over a larger surface area**, are exposed to less seasonal variation and have markedly faster turnover rates than trees.

Phytoplankton **form the base of marine and freshwater food webs** and are **key players in the global carbon cycle**.

They **account for about half of global photosynthetic activity** and at least half of the oxygen production, despite amounting to only about 1% of the global plant biomass.

Phytoplankton are **very diverse**, varying from photosynthesizing bacteria to plant-like algae to armour-plated coccolithophores. Important **groups of phytoplankton include the diatoms, cyanobacteria and dinoflagellates**, although many other groups are represented.

Significance of Phytoplankton's:

- They **contribute more than half of the oxygen** in the environment.
- They **reduce global warming** by absorbing human-induced carbon dioxide.
- They also **serve as the base** of the ocean food chain.
- They **are important bioindicators** regulating life in oceans. Their abundance determines the overall health of the ocean ecosystem.
- The **productive fisheries in the world's ocean** are driven by Phytoplankton blooms.

How mangroves in Odisha likely reduced Cyclone Dana's impact

Sub : Env

Sec: Ecosystem

Context:

- **Cyclone Dana** made landfall near **Bhitarkanika National Park** and **Dhamra Port** in **Odisha.** Although anticipated to cause significant damage, the impact was less severe due to effective measures by state authorities and natural defenses:
    - **Evacuation Efforts**: Over one million people were evacuated to cyclone shelters.
    - **Mangrove Forests as a Natural Barrier**: **Bhitarkanika's dense mangrove cover** played a crucial role in **reducing the cyclone's impact.**

What are Mangroves?

- **Mangroves** are **salt-tolerant trees and shrubs** found in **estuarine** and **intertidal zones,** where **freshwater and saltwater** meet.
- **Characteristics**:
    - Aerial, breathing roots and waxy, succulent leaves.
    - Propagate through seedlings, or propagules, which germinate on the parent tree before dispersing into the water to grow independently.
- **Largest Mangrove Forest**: The **Sundarbans,** spanning **India** and **Bangladesh,** is the world's largest contiguous mangrove forest.
- **Types of Mangroves in India**: Includes species like **Red mangrove,** *Avicennia marina*, and **Grey mangrove,** *Rhizophora.*
- **Locations in India**: Notable mangrove forests are found in:
    - Godavari-Krishna delta in Andhra Pradesh
    - Bhitarkanika in Odisha
    - Andaman Islands, Kerala, Gujarat, Tamil Nadu, and others.

How Mangroves Protect Against Cyclones:

- **Barrier Against Storm Surges**: Mangroves block the flow of storm surges (sea-level rises caused by storms) with their roots, husks, and leaves.
- **Impact on Water Flow**:
    - According to the **World Bank Group,** mangrove species like *Sonneratia apetala* can **reduce surge height** by **4 cm** to **16.5 cm** with strips **50 m** to **2 km wide.**
    - **Mangroves** can also **reduce water flow velocity** by **29%** to **92%** with strips **50 m to 100 m** wide.
- **Combined Defense with Infrastructure**: Mangroves planted in front of embankments further reduce cyclone impacts by decreasing water flow velocity.

Bhitarkanika's Mangrove Forest Cover:

- **Mangrove Area**: Odisha has a mangrove forest area of **231 sq km**, with **Bhitarkanika** holding the majority.
    - **Bhitarkanika** ranks **second** in **India** after **Sundarbans** in terms of **mangrove density.**
    - **82 sq km** in **Bhitarkanika** is **dense mangrove forest,** and **95 sq km** is moderately dense.
- **Wildlife Sanctuary Status**: In **1975**, a coastal area of **672 sq km** was declared the **Bhitarkanika Wildlife Sanctuary.**
    - The **core 145 sq km** area received **National Park status** in **September 1998.**
- **Cyclone Resilience**: Bhitarkanika has withstood multiple cyclones, including the 1999 Super Cyclone, due to its robust mangrove ecosystem.

Karnataka's Rejection of Eco-Sensitive Area Notification for Western Ghats

Sub : Env

Sec: Environmental legislation

Why in News

On September 26, 2023, the **Karnataka government** formally requested the withdrawal of a draft notification from the **Union Ministry of Environment, Forest, and Climate Change (MoEF&CC), which aimed to designate parts of the Western Ghats as Eco-Sensitive Areas (ESAs).** This development follows the government's rejection of the **Kasturirangan committee** report regarding environmental management in the region.

Key points from Kasturirangan committee report

The Kasturirangan committee report proposes **37 per cent of the total area of Western Ghats,** which is roughly 60,000 square kilometres, to be declared as **eco-sensitive area (ESA).**

The state of **Karnataka has the highest percentage of the ESA- 46.50 per cent.**

The **report recommended a blanket ban on mining, quarrying, setting up of red category industries** and **thermal power projects.**

It also stated that the impact of **infrastructural projects on the forest and wildlife should be studied** before permission is given for these activities.

It also stated that **the UNESCO Heritage tag** is an opportunity to build global and domestic recognition of the enormous **natural wealth that exists in the Western Ghats.**

The39 sites are located across the Western Ghats and distributed across the states (Kerala 19), Karnataka (10), Tamil Nadu (6) and Maharashtra (4).

What is an Eco-Sensitive Zone:

The basic aim of ESZ is **to regulate certain activities around National Parks and Wildlife Sanctuaries so as to minimise the negative impacts** of such activities on the fragile ecosystem encompassing the protected areas

ESZs are notified by MoEFCC, Government of India under **Environment Protection Act 1986**

The guidelines include a broad list of **activities that could be allowed, promoted, regulated or promoted**. This is an important checklist for conservationists to keep in mind while identifying threats in ESZs.

For this purpose, the ministry has asked **all states to constitute a committee** comprising the wildlife warden, an ecologist and a revenue department official of the area concerned to suggest the requirement of an eco-sensitive zone and its extent.

The width of the ESZ and type of regulation may vary from protected area to area. However, as a general principle, **the width of the ESZ could go up to 10 kms around the protected area**.

About Western Ghats:

Mountain chain running **parallel to India's western coast, extending from the Satpura Range to Kanyakumari.** Approximately 1,600 km, covering an area of around 140,000 km².

Divided into northern Maharashtra (Sahyadri), Konkan Coast, Kanara, Malabar Coast, and Nilgiri Malai in Tamil Nadu.

Formation: Considered either **block mountains due to land down-warping or faulted edges of the Deccan Plateau.**

Key role in **intercepting southwest monsoon winds,** significantly influencing Indian weather patterns.

Hotspot Status: Recognized as one of the **world's eight 'hottest hotspots' of biodiversity.**

Flora and Fauna: Home to over **1,500 endemic species,** including 325 globally threatened species (IUCN Red List).

Forests: **Tropical evergreen forests** on western slopes and **deciduous forests** on eastern slopes. **Includes Rosewood, Mahogany, Teak, and Sandalwood.**

Endemic Species: Features unique species like **Nilgiritahr and lion-tailed macaque.**

Major Rivers

West-Flowing Rivers: Includes **Periyar, Netravati, and Mandovi;** essential for hydroelectricity due to steep gradients.

East-Flowing Rivers: Includes **Godavari, Krishna, and Kaveri;** slower-moving rivers contributing to larger water bodies.

Home to **India's two biosphere reserves (Agasthya Mala BR and Nilgiris BR) and 13 national parks.**

Hill Stations: Known for popular hill stations like **Mahabaleshwar, Lonavala, and Kodagu,** attracting tourism and contributing to local economies.

Only 10% of nations fulfil their biodiversity commitments ahead of COP16, reveals NBSAP tracker

Sub :Env

Sec: Int Conventions

COP16 Biodiversity Conference:

- Scheduled for October 21 to November 1, 2024
- **Location:** Cali, Colombia
- **First major meeting** since the **2022 Kunming-Montreal Global Biodiversity Framework (GBF)**

Current Progress:

- **Only 10%** of nations have met their **biodiversity protection pledges**
- **20 countries** have fully revised their **National Biodiversity Strategy and Action Plans (NBSAPs)**
- **9 countries** and the **EU** have submitted updated plans as of **June 2024**
- **186 countries,** including **India,** are behind schedule
- Increased participation from civil society, indigenous peoples, and local communities

Monitoring Tool:

- The **National Biodiversity Strategy and Action Plans Tracker (NBSAP)**, a new tool developed by the **World Wildlife Fund for Nature (WWF)**, is monitoring the progress of countries in developing their **NBSAPs** that align with the goals of the **Global Biodiversity Framework (GBF)**.
- **Aims** to track countries' progress in aligning with **GBF goals**

Key Concerns:

- Slow progress in updating national targets (only 33% of countries)
- Lack of measurable objectives in submitted plans
- Insufficient funding for implementation
- Poor integration among government sectors

Challenges:

- Funding shortages
- Difficulty in enacting broader societal changes
- Need for greater transparency and ambition

About Kunming-Montreal Global Biodiversity Framework (GBF):

- The **Global Biodiversity Framework (GBF)** is a crucial international agreement aimed at addressing the global biodiversity crisis.
- **Origin and Adoption:**
  - Officially known as the **Kunming-Montreal Global Biodiversity Framework**
  - Adopted in **December 2022** at the **UN Biodiversity Conference (COP15)** in **Montreal, Canada**
- **Main Goals:**
  - To halt and reverse biodiversity loss by **2030**
  - To achieve a vision of **"living in harmony with nature"** by **2050**
- **Key Targets:**
  - Protect **30%** of Earth's lands, oceans, coastal areas, and inland waters by **2030**
  - Reduce the rate of introduction and establishment of invasive alien species by **50%**
  - Cut global food waste in half
  - Reduce the risk from pesticides and highly hazardous chemicals by at least half
  - Mobilize at least **$200 billion per year** in domestic and international biodiversity-related funding
- **Structure:**
  - **4 goals** to achieve by **2050**
  - **23 action-oriented global targets** for urgent action over the decade to **2030**
- **Funding:**
  - Establishes a **Global Biodiversity Framework Fund**
  - Aims to mobilize resources from all sources, including the private sector
- **Significance:**
  - Considered a **"Paris moment"** for biodiversity, similar to the **Paris Agreement** on climate change
  - Represents a global consensus on the urgent need to address biodiversity loss

As the world converges on Baku for COP29, the Caspian Sea it is located on is threatened with 'catastrophic shrinkage'

Sub :Env

Sec: Int Conventions

Context:

- The drying up of the **Caspian Sea,** the **world's largest enclosed body of water**, due to **human-induced climate change** is becoming an urgent crisis.
- **29th Conference of Parties (CoP)** to the UNFCCC will be held in Capital city of Azerbaijan, Baku, which lies on the shore of the **Caspian Sea.**
- The **Caspian Sea** is threatened with a severe **reduction in water levels.** Scientists estimate that up to a **quarter of the sea** could **vanish within the next 20 years.**

What is threatening the Caspian Sea?

- The **primary factor** behind the Caspian Sea's shrinking is **climate change**.
- According to a 2024 study, the **water level** in the **Caspian** has been largely dependent on **river inflows,** particularly from the **Volga River,** which accounts for over **80%** of the water flowing into the sea.
- The **Volga River**, the **largest in Europe,** plays a critical role in maintaining the sea's hydrological balance.
- However, in recent years, **declining snowfall and precipitation**, linked to **climate change**, have significantly reduced its runoff.
- From **1977** to **2020,** the **Caspian's water level dropped by 133 cm.**

Why is this happening?

- The **warming climate** has been a key factor in this decline.
- As temperatures rise, the Caspian Sea experiences increased **evaporation**, worsened by changing wind patterns.

- When **eastern winds** from **Central Asia,** carrying hot and dry air, prevail over the region, the rate of evaporation accelerates. This intensifies during periods of lower sea levels.

Potential Impacts

- **Environmental Damage**: Similar to the **Aral Sea disaster**, the drying of the Caspian would severely impact **biodiversity, fisheries,** and **ecosystems** in the region.
- **Western Disturbances**: The Caspian plays a role in influencing weather systems, such as **Western Disturbances** that bring rainfall to regions like **India.** A diminished Caspian could alter these patterns, affecting **agriculture and water supplies across Eurasia.**
- **Geopolitical Ramifications**: The Caspian's decline is a serious concern for nations like **Azerbaijan, Russia, Iran, Kazakhstan,** and **Turkmenistan,** which border the sea. Shrinking coastlines could spark disputes over territorial waters and shared resources.

Lessons from the Past

- The **Aral Sea**, once the **world's fourth-largest lake,** dried up largely due to Soviet policies diverting rivers for irrigation. **Iran** has also witnessed the near disappearance of **Lake Urmia**.
- Both cases serve as stark reminders of the devastating effects of mismanaged water systems and the urgent need for international cooperation.

About Caspian Sea:

- The **Caspian Sea,** the **world's largest inland body of water,** is located between **Europe and Asia** and is often referred to as both a lake and a sea due to its vast size and salinity.
- Covering a surface area of **371,000 km²** (143,000 sq mi), approximately the size of **Japan,** the Caspian is a unique **endorheic basin**, meaning it has **no direct outflow** to the world's oceans.
- It is bordered by **Kazakhstan** to the northeast, **Russia** to the northwest, **Azerbaijan** to the southwest, **Iran** to the south, and **Turkmenistan** to the southeast.

Geographical and Ecological Features:

- **Length**: 1,200 km (750 mi) from north to south.
- **Width**: An average of 320 km (200 mi).
- **Salinity**: **1.2%**, about one-third of typical seawater salinity.
- **Main freshwater inflow**: The **Volga River**, Europe's longest river, significantly contributes to the Caspian's hydrology, entering at the shallow northern end.
- **Depth**: The deepest point in the southern basin is **1,023 m** (3,356 ft) below sea level, making it the **third-lowest non-oceanic depression** in the **world.**

Ecological and Economic Significance:

- The Caspian Sea is known for its **caviar industry**, with the **sturgeon population** being crucial for this trade.
- It is also a hub for the **oil industry**, which has contributed both economically and ecologically to the region.
- However, **pollution** from oil extraction, along with the construction of dams on rivers such as the Volga, has harmed the sea's ecology.

Declaration on water security, Global Family Farming Forum take centre stage at WFF

Sub :Env

SEC: Int Conventions

Context:

- **FAO's World Food Forum (WFF)** held in **Rome** from October 14-18.
- The **theme** of the WFF: **"Good food for all, for today and tomorrow."**
- On the sidelines of this, **High-level Rome Water Dialogue**, also took place.

Rome Declaration on Water Scarcity in Agriculture:

- **Adopted by**: Member countries of the **Food and Agriculture Organization (FAO)** of the **United Nations**, Heads of Delegations, and partners of the **Global Framework on Water Scarcity in Agriculture (WASAG)**.
- **Goal**: Address water scarcity in agriculture, which is worsened by climate change.
- **Background**: WASAG was launched at the **2016 United Nations Climate Conference in Marrakesh** to help countries tackle water scarcity.
- **Commitments under the Rome Declaration:**
  - Mobilize greater political support, including:

- o Policy and legal frameworks.
- o Institutional backing.
- o Access to financing.
- o Responsible water governance.
- o Address the impact of water scarcity and climate change on **global food security**, particularly regarding **floods and droughts**.

Key Statistics and Projections:

- By **2050**, more than **half of the global population** will live in areas at risk of water scarcity for at least one month a year.
- Agriculture, which accounts for over **70% of freshwater withdrawals**, is particularly vulnerable.

Global Family Farming Forum (GFFF):

- Launched at: **World Food Forum (WFF)**
- **Joint initiative** of **FAO** and the **International Fund for Agricultural Development (IFAD)**.
- **Family farming**:
  - o Represents over **90% of all farms** globally, with **550 million farms** worldwide.
  - o Produces **70-80% of the world's food** in value terms.
  - o Critical in maintaining **crop biodiversity** and managing natural resources responsibly.
  - o Family farmers, especially in low- and middle-income countries, face multiple crises but hold valuable knowledge for change.
- **United Nations Decade of Family Farming (UNDFF) 2019-2028**: Adopted in **2017**, with **2024** marking the halfway point.
- **Challenges faced by family farmers**:
  - o Despite their essential role in food production, they struggle with accessing:
    - Productive resources.
    - Market opportunities.
    - Essential services.

About the Food and Agriculture Organisation (FAO):

- It's a **specialized agency** of the **United Nations** that leads international efforts to **combat hunger and improve nutrition and food security.**
- Founded in **1945**, headquartered in **Rome, Italy.**
- **Key areas of work include:**
  - o Collecting and analyzing agricultural data
  - o Developing agricultural policies and standards
  - o Providing technical assistance to countries
  - o Responding to food crises and emergencies
  - o Promoting sustainable agriculture and rural development
- **FAO** has **194 member states** and operates in over **130 countries worldwide.**
- Some notable initiatives include the **Global Information and Early Warning System on Food and Agriculture (GIEWS)** and the **Codex Alimentarius international food standards**.

About the International Fund for Agricultural Development (IFAD):

- It's a **specialized agency** of the **United Nations** focused on **eradicating rural poverty in developing countries.**
- Established in **1977** as an outcome of the **1974 World Food Conference.**
- Headquarters: **Rome, Italy.**
- **Key functions:**
  - o Providing low-interest loans and grants to developing countries
  - o Supporting agricultural projects and rural development programs
  - o Empowering rural poor people, especially small farmers
  - o IFAD works primarily in remote rural areas of developing countries.
- **Focus areas** include improving food security, nutrition, and increasing rural people's incomes.
- Emphasizes **sustainable and climate-resilient agriculture**.
- Works closely with rural communities, governments, and other partners.

Climate Finance for Developing Nations: Challenges and Requirements

Sub : Env

Sec Int conventions

Why in News

The upcoming **29th Conference of the Parties (COP29)** of the **United Nations Framework Convention on Climate Change (UNFCCC)**, scheduled to be held in **Baku, Azerbaijan** from November 11 to 22, 2024, is set to focus heavily on **climate finance**. Key discussions will revolve around developing countries' vulnerabilities to climate change and the need for external financial support for mitigation and adaptation efforts.

What is Climate Finance?

According to the **UNFCCC**, climate finance refers to the mobilization of **local, national, or transnational funding**—from **public, private, and alternative sources**—to support actions aimed at mitigating and adapting to climate change. It has two key aspects:

Sources: Public or private financing, whether domestic or international.

End-Uses: Focused on **climate mitigation (reducing emissions) or adaptation (adjusting to climate impacts).**

The Convention, the **Kyoto Protocol** and the **Paris Agreement** call for financial assistance from Parties with more financial resources to those that are less endowed and more vulnerable.

In accordance with the principle of **"common but differentiated responsibility and respective capabilities"** set out in the Convention, developed country Parties are to provide financial resources to assist developing country Parties in implementing the objectives of the UNFCCC.

The **Paris Agreement reaffirms the obligations of developed countries,** while for the first time also encouraging voluntary contributions by other Parties.

The **Organisation for Economic Co-operation and Development (OECD)** regularly reports on financial flows from developed to developing countries.

Why are Developing Countries More Vulnerable?

Geographical Factors: Many developing nations are located in **regions prone to extreme climate events.**

Economic Dependency: Their economies are **more reliant on sectors like agriculture,** which are highly sensitive to climate variations.

Despite this, developing countries have contributed minimally to global emissions. The **Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)** shows that **developed nations** account for **57% of cumulative global emissions** since 1850, despite hosting smaller populations. Meanwhile, developing countries face **competing developmental needs** that limit their ability to take sufficient climate action without external support.

The $100 Billion Pledge

Under the **2009 Copenhagen Accord**, developed nations committed to providing **$100 billion annually in climate finance** to developing countries by 2020. However, the actual disbursement has been called into question, with the need for a new target for the post-2025 period becoming a priority at **COP29**.

India's Climate Finance Requirements

India has ambitious climate targets that necessitate substantial investment:

By **2030**, India aims to install **500 GW of non-fossil-fuel-based generating capacity**, produce **5 million metric tonnes** of **green hydrogen** annually, and promote **electric vehicle (EV) adoption**.

Achieving these targets requires significant financial support:

To achieve **450 GW of renewable energy** by 2030, India would need an estimated investment of **₹16.8 lakh crore**.

India's **National Green Hydrogen Mission** will require an additional **₹8 lakh crore**.

Consumers will need to invest **₹16 lakh crore** to support the EV transition.

In the long-term, India needs a total investment of **₹850 lakh crore** between **2020 and 2070** to reach **net-zero emissions**.

Establishing the New Collective Quantified Goal (NCQG)

A key focus of COP29 is determining a new annual climate finance target—called the **New Collective Quantified Goal (NCQG)**.

Purpose and Background: The **NCQG** is intended to **set a new global climate finance target** for **developed** countries to support developing nations in their climate action efforts. It's meant to **succeed** and **expand upon** the previous goal of mobilizing **$100 billion** annually by 2020, which was established at the **2009 Copenhagen Climate Conference**.

Key Features:

1. **Quantified Goal:** The NCQG aims to establish a specific, measurable target for climate finance.
2. **Collective Effort:** It represents a joint commitment from developed countries, rather than individual national pledges.
3. **Post-2025 Framework:** The **NCQG** is set to **come into effect** after **2025**, building on the previous **$100 billion goal.**

4. **Comprehensive Scope:** It's expected to cover various aspects of climate finance, including mitigation, adaptation, and addressing loss and damage.

Negotiation Process: The **NCQG** is being discussed and negotiated through a series of **technical expert dialogues** and **high-level ministerial meetings** under the **UNFCCC** (United Nations Framework Convention on Climate Change) process.

Challenges: Determining the **NCQG** involves **complex negotiations** around the scale of funding needed, sources of finance, and mechanisms for delivery and transparency.

Importance: The **NCQG** is crucial for **supporting developing countries** in their **climate action efforts** and is seen as a key element in maintaining trust and cooperation in global climate negotiations.

About COP29 of UNFCCC:

Date: Scheduled for November 11-24, 2024

Location: **Baku, Azerbaijan**

It follows **COP28** held in **Dubai, UAE,** in **2023**, which saw significant discussions on the **phase-out of fossil fuels** and the **operationalization of the loss and damage fund.**

World lags on 2030 nature goals headed into UN COP16 talks

Sub: Env

Sec: Int Conventions

Context:

- In **2022**, the world reached its most ambitious agreement **to halt the destruction of nature by 2030.** Two years later, many countries are falling behind on their commitments. As nearly **200 nations** gather for the **COP16 U.N. biodiversity summit** in **Cali, Colombia,** the pressure is on to reaffirm their support for the **Kunming-Montreal Global Biodiversity Framework** and address key concerns, particularly around funding.

Key Points:

- The destruction of nature through activities like **logging** and **overfishing** continues at an alarming rate.
- **COP16 Summit:**
  - This marks the **16th meeting of nations** under the **1992 Convention on Biodiversity.**
  - The focus is on getting countries back on track to meet **2030 targets,** including the **"30 by 30"** goal of preserving **30% of the world's land and sea by 2030.**
- **Lagging Conservation Efforts:**
  - Most countries have yet to submit their **National Biodiversity Strategies and Action Plans (NBSAPs)**, though this was a key commitment before **COP16.**
  - **Only 31 out of 195 countries** had **submitted plans.** Wealthier nations, like **European countries, Australia, Japan, and Canada,** have been quicker to act.
  - The **U.S.** attends but is not obligated to submit a plan, as it **never ratified the Convention.**
  - Developing countries face difficulties due to a **lack of funding and expertise** needed to draft their plans.
- **Funding for Conservation:**
  - A key priority for **COP16** is finding **new financial resources** to help poorer countries meet **biodiversity goals.**
  - During **COP15** in **2022**, countries set a target of **$20 billion annually by 2025** for biodiversity funding in developing nations.
  - However, current funding only reached **$15.4 billion by 2022**, and while the **2025** target is achievable, experts believe it could have been set higher.
- **Global Biodiversity Framework Fund:**
  - A new fund was created after **COP15** to support conservation efforts, but only **$238 million** has been raised so far, far below expectations.

Convention on Biological Diversity (CBD):

- **CBD,** also known as the **Biodiversity Convention,** is a multilateral treaty with **three main objectives:**
1. Conservation of biological diversity
2. Sustainable use of biodiversity components
3. Fair and equitable sharing of benefits from genetic resources
- **Opened for signature**: June 5, 1992 (Earth Summit, Rio de Janeiro)
- **Entered into force**: December 29, 1993
- The **United States** is the only UN member state not to ratify the convention.

Supplementary Agreements

1. **Cartagena Protocol on Biosafety**
- **Purpose**: Governs movement of living modified organisms (LMOs) between countries
- **Adopted**: January 29, 2000
- **Entered into force**: September 11, 2003
2. **Nagoya Protocol**
- **Full name**: Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS)
- **Purpose**: Provides legal framework for fair sharing of genetic resource benefits
- **Adopted**: October 29, 2010 (Nagoya, Japan)
- **Entered into force**: October 12, 2014

Strategic Initiatives

Biodiversity Decade and Strategic Plan
- **2010:** International Year of Biodiversity
- **2011-2020:** UN Decade on Biodiversity
- Strategic Plan for Biodiversity 2011-2020 (includes Aichi Biodiversity Targets)

Conferences of the Parties (COP)
- COP 1: 1994, Nassau, Bahamas
- COP 15: 2021/2022, Kunming, China and Montreal, Canada
- COP 16: Cali, Colombia

Current Focus Areas:

Marine and Coastal Biodiversity
- Identification of Ecologically or Biologically Significant Marine Areas (EBSAs)
- Development of an international **legally binding instrument (ILBI)** for:
  - o Conservation and sustainable use of marine biodiversity
  - o Area-based planning and decision-making under **UNCLOS**
  - o Focus on **areas beyond national jurisdiction (BBNJ treaty/High Seas Treaty)**

The Biodiversity COP

Sub : Env

Sec : Int Conventions

Context:
- Ahead of the annual climate change meeting in **Baku, Azerbaijan** (scheduled for November 11), countries are currently gathered in **Cali, Colombia,** for the **UN Biodiversity Conference,** held **every two years.**

Key points:
- **Convention on Biological Diversity (CBD)**:
  - o Originated from the **1992 Rio Earth Summit,** alongside the **UN Framework Convention on Climate Change (UNFCCC).**
  - o **Aims** to protect biodiversity, restore ecosystems, and ensure equitable distribution of biological resources.
- **COP16 (Conference of Parties to CBD)**:
  - o The **16th meeting** and the first after the landmark **Kunming-Montreal Global Biodiversity Framework**.
  - o Framework set in **2022 (COP15)** with **four goals** and **23 targets** to be achieved by **2030.**
  - o **Key target: 30 x 30** – conserving 30% of land and oceans and restoring 30% of degraded ecosystems by 2030.
- **Biodiversity and Climate Change**:
  - o Both crises are linked, driven by unsustainable resource use and feeding into each other.
  - o **Climate change** exacerbates **biodiversity loss,** while **ecosystem changes** contribute to **global warming.**
  - o Increasing convergence of biodiversity and climate goals.
- **Momentum for 30 x 30**:
  - o **COP16** will push for progress on the **30 x 30 targets.**
  - o Countries must submit **National Biodiversity Strategies and Action Plans (NBSAPs)**, similar to **climate-related NDCs** (Nationally Determined Contributions).

- o **Only 32 of 196 countries** have submitted their **NBSAPs** so far, with more expected during **COP16.**
- **High Seas Treaty**:
  - o Finalized last year to protect biodiversity in international waters.
  - o **Aims** to establish protected areas in oceans and regulate human activities.
  - o Ensures equitable sharing of benefits from genetic resources found in international waters.
- **Genetic Resources Sharing**:
  - o Discussion on sharing benefits from genetic information (e.g., plants and organisms).
  - o **Nagoya Protocol (2010)** established basic principles for **bioresource rights**.
  - o **COP16** will address **digital genetic sequences**, their use, and equitable profit sharing, particularly for indigenous communities.
- **Finance for Biodiversity**:
  - o One of the **Kunming-Montreal Framework's goals** is to mobilize at least **$200 billion per year** for biodiversity conservation by **2030**.
  - o Developed countries are expected to contribute at least **$20 billion annually** to developing nations, increasing to **$30 billion by 2030.**
  - o Discussions at **COP16** will include **new finance mechanisms,** a possible **biodiversity fund,** and **biodiversity credits** similar to **carbon credits**.
- **Elimination of Harmful Subsidies**:
  - o Focus on **phasing out** incentives harmful to biodiversity (e.g., over-fishing, deforestation, fossil fuel subsidies).
  - o Aim to scale up these efforts to at least **$500 billion by 2030**.

India close to finalizing industry carbon targets ahead of Baku climate meet

Sub: Env

Sec: Int Conventions

Context:

In the lead-up to the **29th edition of the Conference of Parties (CoP)** in **Baku, Azerbaijan**, next month, **India** is in the final stages of setting **carbon dioxide emissions intensity targets** for select industries.

Key Points:

- **India** is working on **numerical targets for carbon dioxide emissions intensity** in specific industries. These targets are essential for creating a compliance carbon market.
- Companies must keep their emissions within set limits or buy **credits** from organizations with surplus credits.
- **One credit** is equivalent to saving **one tonne of carbon dioxide** beyond the set target.
- The price of a credit depends on **market demand, supply, and regulatory pressure.**
- **Emissions intensity** refers to caps on carbon emissions per unit of production.
- The **Bureau of Energy Efficiency (BEE)** notified in **December 2023** that India must launch its **compliance carbon market** by the **2025-26 financial year.**
- **Oversight and Governance**:
- The **National Steering Committee for Indian Carbon Market (NSC-ICM)** has **direct oversight** of the **carbon market.** It is **co-chaired** by the **Secretary of the Ministry of Environment, Forest and Climate Change,** and the **Secretary of the Ministry of Power.**
- **Emission Caps for Hard-to-Abate Sectors**:
- **India's emissions targets** are likely to build on the existing **Perform, Achieve and Trade (PAT) Scheme,** which sets energy efficiency targets for industries.
- **Targeted sectors** include aluminium, chlor alkali, cement, fertilisers, iron and steel, pulp and paper, petrochemicals, petroleum refining, and textiles. These sectors are considered **"hard to abate"** because reducing emissions in these industries is expensive.
- **Article 6** of the **Paris Climate Agreement (2015)** outlines how carbon markets, enabling carbon trading between countries, can be operationalised.

About Perform, Achieve & Trade (PAT) Scheme:

PAT Scheme is a **flagship program** under the **National Mission for Enhanced Energy Efficiency (NMEEE).**

Implementing Agency: It is implemented by the **Bureau of Energy Efficiency (BEE)** under the aegis of the **Ministry of Power**.

Objective: The **PAT scheme aims** at reducing **Specific Energy Consumption (SEC),** i.e., energy use per unit of production for **Designated Consumers (DCs)** in energy-intensive sectors, with an associated market mechanism to enhance the cost-effectiveness through certification of excess energy saving, which can be traded.

Energy Saving Certificates (ESCerts):

The excess energy savings are converted into tradable instruments called **Energy Saving Certificates (ESCerts)** that are traded at the Power Exchanges.

Trading Platform: The two Power Exchanges, **India Energy Exchange (IEX)** and **Power Exchange India Limited (PXIL)** provide the trading platform for **ESCerts.**

Central Electricity Regulatory Commission (CERC) is the market regulator for the trading of **ESCerts.**

PAT Scheme is implemented in cycles of **3 years** each, where the Designated Consumers (DCs) are assigned SEC reduction targets.

Designated Consumers (DCs) who fall short of their targets bid for the purchase of ESCerts.

Bureau of Energy Efficiency (BEE):

- **BEE** is a **statutory body** under the **Ministry of Power.**
- The Government of India set up **BEE** on **1st March 2002** under the provisions of the **Energy Conservation Act, 2001.**
- **Mission:** Develop policy and strategies with a thrust on self-regulation and market principles within the overall framework of the Energy Conservation Act (EC Act), 2001.
- **Primary Objective:** To reduce energy intensity in the Indian economy.

Budget Crisis Threatens Future of UN Climate Negotiations and Climate Action Initiatives

Sub : Env

Sec: Int conventions

Why in News

The **United Nations Framework Convention on Climate Change (UNFCCC)** is facing a significant budget crisis, with a shortfall of at least **€57 million.** This deficit raises concerns about the UNFCCC's capacity to conduct **essential climate negotiations and implement crucial agreements** amid global efforts to tackle climate change. Despite some nations exceeding payment obligations, others, including major contributors, have not fulfilled their commitments, exacerbating the financial strain on the UNFCCC.

Overview of the UNFCCC Budget Shortfall:

As of October, the **UNFCCC had received €63 million** in contributions, well below its projected need.

A funding **gap of approximately €57 million has been identified for 2024,** almost half of the budget required for the UNFCCC's operations.

Factors include **logistical challenges and national elections,** causing unprecedented delays in UNFCCC funding.

UNFCCC Funding Structure:

Core Budget: **Mandatory contributions** from **member countries** form the **core budget,** essential for the UNFCCC's foundational operations.

Supplementary Budget: Includes **voluntary contributions** that allow nations to specify project allocations.

Participation Support Fund: Another voluntary fund helps representatives from **developing countries attend climate negotiations.**

About United Nations Framework Convention on Climate Change (UNFCCC):

Established in 1992 at the **Earth Summit in Rio de Janeiro, Brazil.**

Located in Bonn, Germany.

Objective: To **stabilize greenhouse gas concentrations in the atmosphere** to prevent dangerous anthropogenic interference with the climate system.

Signed under the **Earth Summit (United Nations Conference on Environment and Development) in 1992** and entered into force on **21 March 1994.**

Member States: Includes **198 parties,** comprising nearly every country, **including the EU.**

Primary Functions: Coordinates **international climate action, promotes climate negotiations, and monitors commitments** by parties to mitigate climate change.

Kyoto Protocol: A UNFCCC protocol established in **1997 (effective 2005),** setting binding emission reduction targets for developed countries.

Paris Agreement: Adopted in **2015** as an extension of the **UNFCCC to limit global temperature** rise to below **2°C, aiming for 1.5°C** above pre-industrial levels.

Key Mechanisms: Utilizes mechanisms like the **Clean Development Mechanism (CDM)** and **Emission Trading for climate action.**

COP (Conference of the Parties): The **supreme decision-making body of the UNFCCC,** convening **annually** to review climate progress and set new goals.

Green Climate Fund (GCF): Established by the **UNFCCC in 2010** to aid developing countries in climate adaptation and mitigation, with an initial aim to raise **$100 billion per year by 2020.**

IPCC (Intergovernmental Panel on Climate Change): Works alongside the **UNFCCC** to provide **scientific assessments** on **climate change** and its impacts.

Reporting Requirements: All parties are required to **submit regular reports on greenhouse gas emissions,** with **Annex I (developed) countries** facing stricter reporting and reduction commitments.

Loss and Damage Mechanism: Introduced under the **Paris Agreement** to address climate-related loss and damage in vulnerable countries.

Nationally Determined Contributions (NDCs): Core component of the **Paris Agreement where countries voluntarily pledge their climate actions every five years.**

Impacts of the Budget Crisis on Climate Negotiations:

Reduced Operational Capacity: The budget shortfall has forced the **UNFCCC to limit its working hours** and operational resources at its headquarters in Bonn, Germany.

Cancelled Regional Events: Regional **"Climate Week"** events were cancelled, impacting initiatives that previously attracted major climate investments.

Delayed Payments from Major Contributors: Key contributors like the **U.S. and China** have not met their 2024 payment obligations, intensifying the funding crisis.

Impact on Climate Project Funding: The lack of funds reduces UNFCCC's ability to mobilize financial support for projects on **renewable energy and reforestation.**

Hampered Accountability Mechanisms: The shortfall limits UNFCCC's ability to facilitate negotiations, essential for **holding countries accountable** to their **climate pledges.**

A new era for ecosystem: Global Ecosystem Atlas launched at COP16

Sub: Env

Sec: Int Conventions

Global Ecosystems Atlas:

- On October 22, 2024, the **Global Ecosystems Atlas** was **launched** at the **16th COP** to the **United Nations Convention on Biological Diversity (CBD).**

- Created by the **Group on Earth Observations (GEO),** this **first-of-its-kind tool** offers comprehensive **mapping and monitoring of ecosystems worldwide,** addressing crucial global issues such as **biodiversity loss, climate change**, and **land degradation.**

Significance of the Atlas:

- The **Atlas** consolidates **ecosystem information** by integrating **national maps** with **Earth observation data, AI,** and **field data.** It aligns with the **International Union for Conservation of Nature**'s Global Ecosystem Typology, covering terrestrial, freshwater, and marine ecosystems.

- This standardized information helps nations, companies, and communities make informed decisions to manage ecosystems sustainably, aiding in meeting international obligations like the Kunming-Montreal Global Biodiversity Framework.

Global and Local Applications:

- **Governments**: Enables tracking of ecosystem health and progress toward biodiversity commitments.

- **Businesses and Financial Institutions**: Supports risk assessment for sustainable investments.

- **Communities and Indigenous Groups**: Provides data to safeguard and restore ecosystems locally.

- **Academia**: Offers open data for scientific research on global ecosystem trends.

- **Conservation Efforts**: Identifies biodiversity hotspots and monitors the impact of conservation initiatives.

- **Notable Impact**:

    o Countries like **South Africa** and **Mozambique** benefit by aligning national data to enhance **cross-border conservation.** The **Atlas** enables these countries to assess risks jointly, focusing protective efforts on ecosystems they share, such as savannas and coral reefs.

Govt issues guidelines to prohibit greenwashing, misleading green claims

Sub: Env

Sec: Msc

Context:

- The government introduced **new guidelines to regulate greenwashing and misleading environmental claims by companies**. These guidelines **aim** to protect consumers and enhance transparency in eco-friendly marketing.
- **Greenwashing**: Refers to companies making unsubstantiated claims about a product or service having a climate-friendly impact.

Key points of the guideline:

- Issued by the **Consumer Affairs Ministry,** these rules ensure that environmental claims are backed by **verifiable evidence and clear disclosures.**
- The goal is **not to prohibit such claims** but to ensure they are made with **transparency and integrity.**
- **Verification Requirements**:
  - Claims like **"100% eco-friendly", "zero emissions",** and **"cruelty-free"** must be supported by **accurate, verifiable data.**
  - Environmental claims must use **consumer-friendly language,** especially for technical terms.
  - Comparative environmental claims must be based on **relevant, verifiable data,** clearly specifying the basis of comparison.
- **Aspirational Claims**:
  - Future or aspirational environmental claims are allowed but must be backed by actionable plans.
- **Disclosure of Information**:
  - Companies **must disclose all material information** regarding environmental claims through advertisements or communications, using **QR codes, URLs,** or **other digital media.**
  - They must specify if the claim refers to the product as a whole, its manufacturing, packaging, usage, or disposal.
- **Specific Claims**:
  - Claims such as **"compostable", "degradable", "recyclable"**, and **"net-zero"** must be supported by **credible certifications, scientific evidence,** or **third-party verification.**
  - These disclosures should be easily accessible to consumers.
- **Technical Terms**:
  - Companies must explain **technical concepts** like **"environmental impact assessment"** and **"ecological footprint"** in consumer-friendly language.
- **Regulatory Context**:
  - These guidelines complement existing **laws,** and in case of conflicts with specific regulations, those laws will take precedence.
  - The central authority's decision will be final in case of disputes or ambiguity in interpretation.

Where is India's SO₂ control from TPPs headed? NITI Aayog's memo over FGDs fuels debate

Sub: Env

Sec: Pollution

Context:

- **NITI Aayog**'s recent memorandum questioned the need for **flue gas desulfurisation (FGD) in India's TPPs,** following recommendations by **CSIR-NEERI** at a meeting on August 21, 2024.
- **CSIR-NEERI's analysis,** based on data from various monitoring stations and TPPs, found that **only 13 sites exceeded SO₂ limits,** leading to its **recommendation against additional FGD installations.**
- The draft report backing this claim remains unavailable to the public and regulatory bodies.

CSIR-NEERI's Findings:

- Data from **467 Central Control Room stations** and **486 TPP-managed sites** indicate that **ambient SO₂ levels rarely exceed permissible limits.**
- Instead of focusing on **SO₂, NEERI** suggested prioritizing the **control of particulate matter (PM),** which frequently **surpasses limits** based on **Online Continuous Emission Monitoring System (OCEMS)** data.
- **Contrasting Evidence from IIT Delhi**:

- o **IIT Delhi's report** advocates **phased FGD implementation** based on SO_2 **data** from satellite and reanalysis sources (2015-2019).
- o This contradiction raises questions about the accuracy of **NITI Aayog's reliance on CSIR-NEERI's findings alone.**

Historical Timeline of SO_2 Compliance Deadlines:

- **2015**: MoEF&CC introduced strict emission norms, targeting a **2017** compliance deadline for TPPs.
- **2017**: An extension was granted, pushing deadlines to **2022**.
- **2020-2021**: Compliance categories (A, B, and C) were created, each with staggered deadlines based on pollution and population levels.
    - o The compliance deadlines for parameters other than SO_2 **norms** varied by category. **Category A** covered plants located within a **10-kilometre radius of NCR or cities with populations exceeding one million.** These plants must meet compliance requirements by December 31, 2022.
    - o **Category B** included plants within a **10-km radius of critically polluted areas or non-attainment cities,** with a deadline of December 31, 2023. Lastly, **Category C** encompasses **all remaining plants,** which were expected to comply by December 31, 2024.
    - o The categorisation by the task force puts approximately **22 per cent** of the capacity in **Category A** and **Category B.** Nearly 78 per cent of the coal power capacity is placed under Category C.
- **2022**: Revised deadlines extended the final SO_2 compliance date to **2026** for **Category C** plants.
- **Current Status of FGD Installation**:
    - o **FGD** is installed in **39 units** (19,430 MW) and is in progress in **238 units** (105,200 MW).
    - o Tendering is ongoing in **139 units** (42,847 MW), and pre-tendering for **121 units** (36,683 MW) is underway.

Health and Environmental Concerns:

- **India, as the world's top SO_2 emitter since 2019,** has been urged to **control SO_2** due to severe health risks linked to respiratory and cardiovascular diseases.
- SO_2 **emissions** from **coal combustion** contribute to **particulate pollution (PM2.5)**, which worsens air quality and health outcomes.

Flue Gas Desulphurisation (FED):

- **Removal of Sulfur Dioxide** is called as Flue-gas Desulphurization (FGD).
- It seeks to remove gaseous pollutants viz. $SO2$ from **exhaust flue gases** generated in **furnaces, boilers, and other industrial processes** due to thermal processing, treatment, and combustion.
- **FGD systems** may involve **wet scrubbing or dry scrubbing.**
- **In wet FGD systems,** flue gases are brought in contact with an absorbent, which can be either a **liquid** or a **slurry of solid material.** The **sulfur dioxide** dissolves in or reacts with the absorbent and becomes trapped in it.
- **In dry FGD systems,** the absorbent is dry pulverized lime or limestone; once absorption occurs, the solid particles are removed by means of baghouse filters.

Benefits of Flue Gas Desulphurisation (FED):

- According to the **Centre for Atmospheric Science, IIT Delhi,** an FGD unit can remove anywhere between **50** and **99.8 per cent** of **SOx emissions,** depending on the power plant's vintage.

Sulphur Dioxide Pollution:

- According to a report by Greenpeace (an environmental Non-Governmental Organization), **India is the largest emitter of Sulphur Dioxide (SO2)** in the world
- The **primary reason** for India's high emission output is the **expansion of coal-based electricity generation** over the past decade.

Source:

- The largest source of $SO2$ in the atmosphere is the **burning of fossil fuels** by power plants and other industrial facilities.
- Smaller sources of $SO2$ emissions include: industrial processes such as extracting metal from ore; **natural sources such as volcanoes**; **and locomotives, ships** and other vehicles and heavy **equipment** that **burn fuel with a high sulfur content**.

Impact: SO2 can affect both **health and the environment.**

- Sulphur dioxide is bad for health and the environment.
- **Short-term exposures** to SO2 can **harm the human respiratory system** and make breathing difficult. People with **asthma**, particularly children, are sensitive to these effects of SO2.

- SO2 emissions that lead to high concentrations of SO2 in the air generally also lead to the **formation of other sulfur oxides (SOx)**. SOx can react with other compounds in the atmosphere to form small particles. These particles **contribute to particulate matter (PM) pollution.**
- Small particles may penetrate d**eeply into the lungs and in sufficient quantities can contribute to health problems**.
- At high concentrations, SO2 can harm trees by damaging foliage and stunting growth. When the gas mixes with falling raindrops, we get a **shower of sulphuric acid.**

Delhi's Air Pollution Crisis: Causes, Trends, and Mitigation Measures

Sub: Env

Sec: Pollution

Why in News

Delhi's air quality has deteriorated significantly as **particulate matter (PM 2.5) levels rise to over 10 times the safe limit** prescribed by the **World Health Organization (WHO).** The seasonal spike in pollution levels, aggravated by stubble burning in neighbouring states, Deepavali festivities, and meteorological conditions, has raised concerns about severe health impacts and the need for coordinated action across states.

Overview of Delhi's Pollution Problem:

PM2.5 levels in Delhi recently soared to **160 micrograms per cubic meter,** surpassing the **WHO's permissible limit of 15 micrograms.**

Delhi's 24-hour average Air Quality Index (AQI) reached 356 on October 23, placing it in the **"very poor"** category, with predictions of **further deterioration if firecracker bans are not enforced during Deepavali.**

Stubble burning in Punjab and Haryana coincides with this period, compounding **Delhi's air quality crisis.**

According to Climate Trends, 54% of the wind from Punjab and 27% from Haryana carries particulate matter to Delhi. **Each stubble-burning incident increases PM2.5 levels by 12.44 units on average.**

Transportation within Delhi and vehicles entering the city **contribute about 18% of PM2.5 levels.** Vehicular emissions are especially high due to **Delhi's dense traffic and industrial activities.**

Secondary Inorganic Aerosols (SIAs): SIAs, formed when **sulphur dioxide (SO2), nitrogen oxides (NOx), and ammonia (NH3)** react to **create ammonium sulphate and nitrate,** contribute up to 32% of Delhi's winter pollution. **Nearly 84% of SIAs originate outside Delhi,** underscoring the need for cross-state solutions.

Meteorological Factors: **Winter months bring a sharp reduction in wind speed, which prevents pollutants from dispersing and causes them to remain concentrated near ground level.**

AQI Index score:

The **AQI** transforms complex air quality data of various pollutants into a single number for ease of understanding. The pollutants include **PM 10, PM 2.5, Nitrogen Dioxide, Ozone, Carbon, etc.**

Pollutants	Description
PM 2.5 and PM 10	- These are extremely fine particulate matter (PM) particles. - PM 10 and PM 2.5 are smaller than 10 and 2.5 microns in their diameter, respectively. - The **PM 2.5** particles can easily bypass the nose and throat and can enter the circulatory system. - The particles can also lead to **chronic diseases** such as asthma, heart attack, bronchitis and other respiratory problems. **Byproducts of emissions** from factories, vehicular pollution, construction activities and road dust, such particles are not dispersed and stay suspended in the air that we breathe.

Nitrogen Oxides (NOx)	- It gets in the air from the burning of fuel, with sources including emissions from **vehicles and power plants.** **Short-term exposure** to **high levels of NO2** can aggravate **respiratory diseases** like **asthma,** and lead to other problems such as coughing or difficulty in breathing. **Long-term exposure** may also contribute to the development of asthma and could increase susceptibility to respiratory infections.
Ozone	- The **surface-level ozone** is among the most significant air pollutants. It is formed by the reaction of **atmospheric pollutants** in the **presence of sunlight.** **Related health hazards include:** Chronic Obstructive Pulmonary Disease (COPD), and cardiovascular and respiratory deaths.
Sulfur Dioxide (SO2)	- The **largest source of SO2** in the atmosphere is the **burning of fossil fuels** by power plants and other industrial facilities. Additional sources are industrial processes and natural sources such as volcanoes. **Health hazards include:** Damage to the cardiovascular system and respiratory illnesses. **SO2** can also **react with other compounds** to form **particulate matter.** - At high concentrations, **gaseous SOx** can harm **trees and plants** by damaging foliage and decreasing growth.
Ammonia (NH3)	- A broad **increase in fertilizer use** coupled with **large contributions** from **livestock waste** have resulted in the **world's highest concentrations of atmospheric ammonia** in **India**. - While **gaseous ammonia** is a **natural part of Earth's nitrogen cycle,** excess ammonia is harmful to plants and reduces air and water quality. - In the **troposphere ammonia gas** reacts with **nitric** and **sulfuric acids** to form **nitrate-containing particles.** Those particles contribute to **aerosol pollution** that is damaging to human health. **Ammonia gas** can also fall back to Earth and enter **lakes, streams and oceans,** where it contributes to **harmful algal blooms** and **dead zones** with dangerously **low oxygen levels**
Lead (Pb)	- It is a **naturally occurring toxic metal** found in the **Earth's crust.** - But in **increased quantities, exposure** to it becomes **extremely dangerous to health.** - Important sources of **environmental contamination** come from **mining, smelting, manufacturing** and even recycling activities. **Young children** are particularly vulnerable to lead poisoning because **they absorb four to five times** as much ingested lead as adults from a given source. - Children who survive severe lead poisoning may be left with **permanent intellectual disability** and **behavioural disorders.** At **lower levels of exposure** that cause no obvious symptoms, lead is now known to produce a spectrum of injury across multiple body systems. - There is no known safe level of exposure to lead contamination.
Carbon Monoxide (CO)	- A **toxic, colourless** and **odourless gas,** it is given off when **fuel containing carbon**, such as **wood, coal and petrol,** is **burned.** - If **CO levels** are **high enough**, a person may become **unconscious and die.** **Long-term exposure** has been linked with an **increased risk of heart disease.**

WHO global air quality norms:

The **World Health Organization (WHO)** has raised the bar further to safeguard public health even before the global community could comply with the current benchmarks for clean air.

The WHO's new air quality guidelines — **Global Air Quality Guidelines (AQGs)** — released September 22, 2021, has redefined the threshold of safe air.

This is the **first revision after the last updating in 2005** — about 15 years ago. Currently, 90 per cent of the global population and nearly everyone in India is breathing air that defies the current guidelines of the WHO.

The primary focus is on **significant tightening of the guidelines for particulate matter, which is responsible for the highest number of air pollution related deaths worldwide** — nearly seven million. The guidelines for key gases have also been revised.

Pollutant	Averaging time	2005 AQGs	2021 AQG level
$PM_{2.5}$, $\mu g/m^3$	Annual	10	5
	24-hour[a]	25	15
PM_{10}, $\mu g/m^3$	Annual	20	15
	24-hour[a]	50	45
O_3, $\mu g/m^3$	Peak season[b]	–	60
	8-hour[a]	100	100
NO_2, $\mu g/m^3$	Annual	40	10
	24-hour[a]	–	25
SO_2, $\mu g/m^3$	24-hour[a]	20	40
CO, mg/m^3	24-hour[a]	–	4

Need for Coordinated Action:

Airshed Approach: The **"airshed approach"** involves a **cross-state, regional strategy to tackle air pollution** by addressing sources beyond Delhi's borders. Coordinated policy measures involving Punjab, Haryana, Uttar Pradesh, and Rajasthan, along with Delhi, are essential for meaningful air quality improvements.

Centralized Monitoring and Forecasting: The **Indian Institute of Tropical Meteorology-Pune (IITM-Pune)** maintains an air quality forecast system for cities across India, helping predict pollution trends and identify periods when stubble burning may significantly affect Delhi's AQI.

Government-led **Air Quality Early Warning Systems** provide valuable data that can inform proactive measures, such as **limiting vehicle emissions and restricting industrial activities** during high-pollution days.

Long-term solutions include **incentivizing alternative crop-clearing methods, increasing green cover, and promoting cleaner transport options.**

Why a proposed Eco-Sensitive Zone around Gir forest is facing protests
Sub: Env

Sec: Protected Areas

Context:

- On September 18, the **Ministry of Environment, Forest and Climate Change (MoEFCC)** proposed notifying **3,328 sq km** around the **Gir forest** in **Gujarat** as an **Eco-Sensitive Zone (ESZ).**
- A week later, the area was **reduced to 2,061 sq km** to accommodate the needs of people living near the forest.

Reasons for Protests:

- Farmers argue that restrictions in **ESZs** limit their ability to protect their crops from wildlife, such as the **Asiatic lions.**
- Local leaders and organizations, like the Bharatiya Kisan Sangh, are concerned about the **negative impact on businesses, tourism (resorts),** and **small industries** due to the restricted permissions in ESZs.

Previous Disputes:

- In **2016,** a similar proposal for a **3,328 sq km ESZ** led to protests. **Farmers' rights to self-defence against wild animals** were cited as the reason.
- After complaints, the Gujarat government revised the **ESZ area,** reducing it to **1,114 sq km,** which was challenged in court.
- To date, the Gujarat High Court has prevented the final notification.

Gir's Uniqueness:

- **Protected Area**: **Gir National Park** along with other sanctuaries is the **last remaining habitat of Asiatic lions.**

- **Human-Wildlife Coexistence**: Despite some conflicts (like livestock loss), local communities generally tolerate and support lion conservation.
- **Lion Population Growth**: Due to conservation efforts, the **lion population increased** from **327** in **2001** to **674** in **2020.**

Process of Declaring an ESZ:

1. State forest departments submit ESZ proposals for each Protected Area.
2. MoEFCC issues a draft notification, inviting public feedback within 60 days.
3. After receiving suggestions and the state's response, the ministry finalizes the ESZ notification based on recommendations from an expert committee.

Ecologically Sensitive Zones (ESZs) in India

- **Ecologically Sensitive Zones (ESZs)** are areas notified by the **Ministry of Environment, Forests and Climate Change (MoEFCC),** Government of India around Protected Areas, National Parks, and Wildlife Sanctuaries. These zones act as **"shock absorbers" or "buffers"** for the protected areas by regulating and managing the activities around such areas.
- **Key Guidelines:**

1. **ESZ** notification under **Section 3** of the **Environment (Protection) Act, 1986**
2. Supreme Court directions regarding **mandatory ESZ of 10 km around protected areas (unless specifically altered)**
3. Guidelines for Declaration of ESZ around National Parks and Wildlife Sanctuaries dated February 9, 2011

Extent and Boundaries

Standard ESZ Area

- **Minimum: Up to 100 meters** from the protected area boundary
- **Maximum: Up to 10 kilometres** from the protected area boundary
- **Case-specific variations based on:**
  - Geographical features
  - Population density
  - Economic needs
  - Environmental requirements

Activities in ESZs:

Prohibited Activities	Regulated Activities	Permitted Activities
1. Commercial mining and quarrying 2. Setting up of sawmills 3. Commercial use of wood 4. Setting up of polluting industries 5. Establishment of major hydroelectric projects 6. Use or production of hazardous substances 7. Tourism activities like flying aircraft, hot air balloons over protected areas 8. Discharge of untreated effluents	1. Tree felling 2. Establishment of hotels and resorts 3. Commercial use of natural water resources 4. Erection of electrical cables 5. Widening of roads 6. Introduction of exotic species 7. Agriculture systems 8. Small-scale industries not causing pollution	1. Ongoing agricultural practices 2. Rainwater harvesting 3. Organic farming 4. Adoption of green technology 5. Cottage industries 6. Use of renewable energy sources 7. Restoration of degraded land/forests 8. Small-scale community-based facilities

Penalties for Violations:

- Under Environment (Protection) Act, 1986:
  - Imprisonment up to 5 years
  - Fine up to ₹1 lakh
  - Additional fine of ₹5,000 per day for continuing violations

Asiatic lion

- Asiatic lion (Panthera leo persica) is a sub-species of lion that is found only in the Gir Forest National Park and Wildlife Sanctuary in Gujarat, India.
- The Asiatic lion is one of the most endangered big cats in the world, with a population of **less than 700 individuals in the wild.**

- The Asiatic lion is found **only in the Gir Forest National Park and Wildlife Sanctuary**, which is a protected area covering an area of about 1412 sq km in Gujarat.
- The Asiatic lion is **slightly smaller than its African counterpart**, with a distinctive fold of skin on its belly and a shorter, less bushy mane.
- The Asiatic lion's diet mainly consists **of deer, antelope, and wild boar,** although it may also prey on domestic livestock in areas surrounding the Gir forest.
- Cultural significance: The Asiatic lion has c**ultural significance in India, where it is revered as a symbol of power, courage, and royalty,** and is depicted in several ancient Indian artworks and scriptures.
- **Conservation Status**
    o Wildlife (Protection) Act 1972: **Schedule 1**
    o CITES :**Appendix I**
    o IUCN Red List: **Endangered**
- The Asiatic lion faces several challenges to its survival, including habitat loss, fragmentation, and human-wildlife conflict.

Barda Wildlife Sanctuary

- Barda Wildlife Sanctuary is a protected area **located in the Porbandar district** of Gujarat, India. It covers an area of about 192 sq km and is located in the **foothills of the Aravalli Range in Gujarat.**
- The vegetation in the sanctuary includes **dry deciduous forest, scrubland, and grassland.**
- The sanctuary is home to a **diverse range of flora and fauna**, including leopard, hyena, jackal, sloth bear, jungle cat, Indian civet, and several species of birds and reptiles.
- Barda Wildlife Sanctuary is **connected to several other protected areas in the region**, including Gir National Park and Wildlife Sanctuary, Pania Wildlife Sanctuary, and Jamjir Wildlife Sanctuary, which together form a contiguous wildlife habitat.
- Barda Wildlife Sanctuary is **recognized as an Important Bird Area (IBA) by BirdLife International.**
- Threats: The Barda Wildlife Sanctuary faces several threats, including poaching, habitat loss and fragmentation, and human-wildlife conflict.

Odisha introduces female tiger to check inbreeding in Similipal Reserve
Sub : Env

Sec :Protected Area

Context:
- The **Odisha government** recently translocated a **female tiger** from **Maharashtra's Tadoba-Andhari Tiger Reserve** to **Odisha's Similipal Tiger Reserve** to improve genetic diversity in its tiger population.

Tiger Translocation Details:
- Odisha introduced a female tiger, aged two years and seven months, to Similipal as part of a plan to add two tigresses.
- **Reason for Translocation**:
    o **Odisha** requested the **National Tiger Conservation Authority** to introduce female tigers from different landscapes into Similipal.
    o This is due to **inbreeding issues** in **Similipal's tiger population,** which has led to the **emergence of pseudo-melanistic (black-striped) tigers.**
- **Similipal's Tiger Population**:
    o The **All Odisha Tiger Estimation (AOTE-2023-24)** reported **30 tigers** in **Odisha's forests,** with **27 residing in Similipal.**
    o **Similipal** has **13 adult pseudo-melanistic tigers** (seven females and six males), a unique phenomenon in wild habitats worldwide.

Pseudo-Melanistic Tiger Study:
- A study, *High Frequency of an Otherwise Rare Phenotype in a Small and Isolated Tiger Population* reveals that about **37%** of **Similipal's tigers** are **pseudo-melanistic,** with wide, merged stripes.
- The study suggests these unique traits are likely due to **strong inbreeding and local genetic factors.**
- Odisha has proposed the **world's first melanistic tiger safari** in **Similipal's buffer region** to promote conservation and tourism.

Black Tigers or Melanistic Tigers:

- **Melanism** is a **genetic condition** in which an **increased production of melanin**, a substance in the **skin** that produces **hair, eye** and **skin pigmentation,** results in **black (or nearly black) skin**, feathers or hair in an animal.
- Many **royal Bengal tigers** of **Similipal** belong to a unique lineage with **higher-than-normal levels of melanin,** which gives them black and yellow interspersed stripes on their coats.
- These tigers are **not entirely black**, and are therefore more accurately described as being **pseudo-melanistic.**
- As per the **2022 cycle** of the **All-India Tiger Estimation**, **16 individuals** were recorded at **STR**, out of which **10 were melanistic.**
- **What Makes Tigers (Pseudo) Melanistic?**
    - According to research of the **National Centre for Biological Sciences (NBCS, Bengaluru),** a single mutation in the gene **Transmembrane Aminopeptidase Q (Taqpep)** causes **black tigers' stripes** to enlarge or spread into the yellow background.
    - Genetic analyses of other tiger populations in India and computer simulations suggest that the **Similipal black tigers** may have arisen from a very small founding population of tigers, and are inbred.
    - The **STR** cats live isolated from other tigers, because of which they breed among themselves.

Similipal Tiger Reserve (STR):
- Similipal is a tiger reserve in the **Mayurbhanj district** (adjoining Jharkhand and West Bengal) in the **Indian state of Odisha** covering 2,750 km2 (1,060 sq mi).
- It is part of the **Mayurbhanj Elephant Reserve,** which includes **three protected areas - Similipal Tiger Reserve, Hadagarh Wildlife Sanctuary** and **Kuldiha Wildlife Sanctuary.**
- **Simlipal National Park** derives its name from the abundance of **red silk cotton trees** growing in the area.
- The park is home to the **Bengal tiger, Asian elephant, gaur** and **chausingha**, and this protected area is part of the **UNESCO World Network of Biosphere Reserves** since **2009.**
- The **STR** is **Asia's second largest biosphere** (after the **Gulf of Kachchh, Gujarat**), and the **country's only wild habitat for melanistic royal Bengal tigers.**

What's behind the deaths of 7 elephants in 2 days in Madhya Pradesh's Bandhavgarh National Park?
Sub : Env

Sec: Protected Areas

Context:
- The death toll of elephants in **Bandhavgarh National Park, Madhya Pradesh,** has risen to seven.
- **Potential Causes of Death**:
    - Elephants may have consumed **pesticide-infected crops outside the forest,** but further investigation is needed.

Bandhavgarh National Park:
- Located in the **Vindhya Hills** of **Umaria district, Madhya Pradesh, Bandhavgarh** was declared a **national park** in **1968,** covering **105 square kilometers.**
- Known for its **Royal Bengal Tiger population,** it saw its first herd of elephants in **2018,** which migrated from **Chhattisgarh** and settled in the park. Currently, around 60 elephants reside there.
- **History & Geography:**
    - Originally a hunting ground for the **Maharajas of Rewa**
    - Features the ancient **Bandhavgarh Fort**, believed to be over **2000 years old**
    - Covers approximately 450 sq km of core area, plus a larger buffer zone
    - Known for its v**aried topography including** steep ridges, dense bamboo forests, and grasslands
- **Wildlife:**
    - Famous for having **one of India's highest densities of Bengal tigers**
    - Home to other big cats like **leopards**
    - Large population of **deer species** including **spotted deer, sambar,** and **barking deer**
    - Rich bird life with over 250 species
    - Other wildlife includes **sloth bears, wild boars,** and various primates
- **Notable Features:**
    - Divided into several tourism zones including **Tala, Magdhi,** and **Khitauli**
    - Best known for tiger sightings and wildlife photography opportunities
    - Ancient caves with human artefacts and rock paintings

o The **highest density of Royal Bengal Tigers** in India

Tsetse fly present in 34 countries in Africa, confirms FAO atlas

<u>**Sub: Env**</u>

<u>**Sec: Species in news**</u>

New Atlas Reveals Tsetse Fly Distribution in Africa:

- The **Food and Agriculture Organization of the United Nations (FAO)** has published a **new atlas** showing the presence of **tsetse flies** in **34 African countries.** This is a significant update, as the last comprehensive map was created over **50 years ago.**

What are Tsetse Flies?

- **Tsetse flies** belong to the genus **Glossina**
- They transmit **trypanosomes**, unicellular parasites that cause:
    - **Sleeping sickness** in **humans**
    - **Nagana** in **African livestock**

Impact:

- **Human cases:** Sleeping sickness is **no longer a major public health issue**, with annual cases below **2,000**
- **Livestock: Tsetse flies** continue to have a significant impact, causing estimated **annual agricultural losses** in the **billions of dollars**

The New FAO Atlas:

- **Data sources: 669** scientific papers from **1990** to **2020**
- **Methods:** Combines **Google Earth geolocation data** with **entomological fieldwork**
- **Scope:** Analyzed **7,386** sites across Africa

Key Findings:

1. Confirmed presence of **Glossina species** in **34 countries**
2. **Geographical range:** From **Northern Senegal (15°N)** to **South Africa** (**Kwazulu-Natal province** at **5 degrees** south)
3. **Most widespread species:**
    - **West Africa:** Glossina palpalis and Glossina tachinoides
    - **Central Africa:** Glossina fuscipes
    - **East and Southern Africa:** Glossina morsitans and Glossina pallidipes

Data Gaps and Limitations:

- No published data was found for **Burundi, Guinea-Bissau, Liberia, Sierra Leone,** and **Somalia** (These countries are still considered affected by tsetse flies)
- **Limited information for: Angola, Congo, the Democratic Republic of Congo,** and **South Sudan**
- **North African countries** historically **free of tsetse flies** were not included

Importance of the Atlas:

- Aids veterinary practitioners and policymakers in affected countries
- Assists international organisations like **WHO** in fighting **sleeping sickness** and **animal trypanosomiasis**
- Helps establish a reference for **tsetse fly** and **African animal trypanosomosis distribution** (e.g., in **western Ethiopia**)

Declining Swallowtail Butterflies in Assam: A Call for Conservation

Sub: Env

Sec: Species in news

Why in the News

A recent study highlights the **alarming decline of swallowtail butterflies in Assam's Bodoland Territorial Region,** primarily due to **habitat loss and overexploitation** of their host plants. The findings underscore the need for urgent conservation measures in this biodiversity-rich area.

About Swallowtail Butterflies

Family: Papilionidae

Global Species: 573 species

Species in India: 77 species, including:

Papilio paris (Paris peacock)

Papilio machaon (Common Yellow Swallowtail)

Papilio polytes (Common Mormon)

Papilio demoleus (Lime Butterfly)

Atrophaneura species (Red-bodied Swallowtail)

Teinopalpus imperialis (Kaiser-i-Hind)

Physical Traits: Large size, **brightly colored wings, and tail-like extensions on hindwings.**

Behavior: Strong fliers, **diurnal activity**, and territorial nature; primarily feed on nectar.

Global Range: Found in tropical and temperate regions across **Asia, Africa,** and the **Americas**.

Environmental Indicators: Butterflies serve as **key indicators of environmental health**, with their abundance and diversity reflecting the condition of their habitats.

Supportive Ecosystem: The Bodoland Territorial Region, covering **8,970 sq. km**, has around **40%** forest cover, crucial for supporting various plant species that are food sources for swallowtail larvae.

Swallowtail-rich Zone: The northeastern region, particularly Assam, is designated as a **"swallowtail-rich zone"** by the International Union for Conservation of Nature (IUCN), with **69 species** documented here.

Habitat in India: Commonly inhabits rainforests, woodlands, cultivated lands, and protected areas such as the **Western Ghats** and **Northeast India**.

Feeding Requirements: Depend on specific plant families for larval development, including: **Rutaceae** (citrus plants), **Aristolochiaceae**, **Lauraceae** and **Magnoliaceae**

Swallowtail Conservation Action Plan (SCAP): To protect endangered swallowtail species and prevent extinction. Northeastern India identified as a crucial conservation area under SCAP.

Legal Protection: 12 swallowtail species in India are federally protected. Some species are listed under **Schedule I of the Wildlife Protection Act**.

Habitat Degradation

Agriculture and Tea Cultivation: Proximity to agricultural activities and tea cultivation near butterfly habitats is detrimental to their survival.

Illegal Activities: Illegal cattle farming and tree felling within protected areas further exacerbate the situation.

Pesticide Use: The application of pesticides contributes to the declining health of butterfly populations.

The Citrus Connection

Citrus Belt: The North-east region is recognized as the **"citrus belt of the world,"** hosting **52 varieties of 17 citrus species** and **six hybrid species**. The northeastern region of India includes states like Assam, Meghalaya, Arunachal Pradesh, Manipur, Nagaland, and Mizoram.

The Citrus Belt refers to regions **where citrus fruits (such as oranges, lemons, limes, and grapefruits) are extensively cultivated.**

Topography: Characterized by hilly terrain, valleys, and a diverse range of ecosystems. The region benefits from a subtropical climate conducive to citrus cultivation.

Key Varieties Grown: Oranges (especially mandarin), Lemons and Grapefruits.

Link to Swallowtails: The decline in wild citrus populations is linked to the disappearance of certain butterfly species, particularly those in the **Papilio** genus.

Indian elephants lost genetic vigour as they moved north to south, 5 distinct populations exist: Study

Sub : Env

Sec: Species in news

Context:

- A team of researchers from the **National Centre for Biological Sciences (NCBS)** and the **Indian Institute of Science (IISc), Bengaluru,** has discovered that **Indian elephants migrated from the north to the south over millennia, gradually losing genetic diversity with each migration.**

- Their study analysed **whole genome sequences** from both **wild and captive elephants** across **India,** identifying **five genetically distinct populations.**

Key Findings:

- **Five Distinct Elephant Populations**:
    - One population along the **Himalayan foothills** (northwest to northeast)
    - One in **central India**
    - **Three** in **southern India**

- **Population Estimates (2017 Census)**:
  - **Total elephants in India**: Over 29,000
  - **Southern populations**: 14,500
  - **Central population**: 3,000+
  - **Northern population**: 12,000 (2,000 in the northwest, 10,000 in the northeast)

Genetic Divergence and Migration:
- The **northern population** diverged from other populations more than **70,000 years ago**.
- **Central Indian elephants** diverged around **50,000 years ago**.
- The **three southern populations** diverged only about **20,000 years ago**.

Genetic Diversity and Conservation:
- The **southern populations** show **reduced genetic variation**, likely due to the **"serial founder effect,"** where smaller groups of individuals migrated southward, establishing new populations.
- This reduced variation increases the risk of **inbreeding depression** (harmful genetic traits due to related individuals breeding).
- The **southernmost population** (fewer than 150 elephants, south of the Shencottah Gap) has the **lowest genetic diversity** and is highly vulnerable to extinction.

Insights on Barriers to Elephant Movement:
- The **Palghat Gap** and **Shencottah Gap** in the **Western Ghats** have acted as natural barriers, leading to **three distinct southern elephant populations:**
  - North of Palghat
  - Between Palghat and Shencottah
  - South of Shencottah
- The study also confirmed two previously identified populations:
  - **Central Indian elephants** (from southwestern West Bengal to eastern Maharashtra)
  - **Northern elephants** (in Uttarakhand, Uttar Pradesh, and the Northeast, separated by the Ganga and Brahmaputra rivers)

Importance of Habitat Connectivity:
- The **north Indian elephant landscape**, from **Uttarakhand** to **Arunachal Pradesh**, once formed a single connected population. However, recent **infrastructure development** has disrupted gene flow, particularly in the **Western Ghats**.
- The researchers emphasize the need for **region-specific conservation** strategies, given the genetic differences between populations.
- The team plans to develop a **genetic toolkit** using **DNA** from **elephant feces** to monitor populations more accurately and identify individual elephants in the wild.

Odisha's leopard population jumps by 22% to 696

Sub: Env

Sec: Species in news

Context:
- The **All Odisha Leopard Estimation 2024** has been released.

Current Population Status in Odisha:
- **Latest count (2024): 696** leopards (range: 668-724)
- **22%** increase from **2022** (568 leopards)
- Still below **2018 levels** (**760** leopards)

National Context:
- India's total leopard population: **13,874**
- Historical decline: **75-90% reduction** over past 120-200 years
- National poaching statistics: 1,485 leopards in last 10 years

Survey Methodology:
- Coverage: 47 forest divisions
- Methods used:
  - Field surveys for indirect evidence (pugmarks, scrapes, scats, etc.)

- o Camera traps for identification through rosette patterns
- o Scientific monitoring of direct and indirect evidence

Key Findings

1. **Protected Areas:**
   - o **Similipal Tiger Reserve:** Largest leopard population
     - ▪ Connected to **Hadagarh Wildlife Sanctuary** and **Kuldiha Wildlife Sanctuary,** which is essential for **leopards** to disperse from **Similipal** to these other protected areas.

About Similipal National Park:

- Simlipal is a **tiger reserve in the Mayurbhanj district** in the Indian state of Odisha

- It is **part of the Mayurbhanj Elephant Reserve**, which includes three protected areas -Similipal Tiger Reserve, Hadgarh Wildlife Sanctuary and Kuldiha Wildlife Sanctuary.

- Simlipal National Park **derives its name from the abundance of red silk cotton trees** growing in the area.

- The vast terrain of Similipal with wide altitudinal, climatic and topographic variations, criss-crossed by large number of perennial streams, harbours a **unique blend of Western Ghats, Eastern Ghats and Sub-Himalayan plant species**.

- The floristic composition indicates a **connecting link between South Indian and North Eastern Sub-Himalayan Specie**

- Forest is **predominantly moist mixed deciduous forest** with **tropical semi-evergreen forest in areas** with suitable microclimatic conditions and sporadic patches of dry deciduous forests and grasslands. It forms the **largest watershed of northern Odisha.**

- It holds the **highest tiger population in Odisha**, and harbours the **only population of melanistic tigers in the world**.

- Other carnivores found here are **leopard, leopard cat, fishing cat, jungle cat and wolf**. The active **management of mugger** has revived its population on the banks of the rivers Khairi and Deo.

- Similipal Tiger Reserve is also **home to the largest population of elephants in Odisha**.

- This protected area is **part of the UNESCO World Network of Biosphere Reserves** since 2009.

- **Satkosia landscape:** Second highest population

- **Hirakud Wildlife Division (including Debrigarh Wildlife Sanctuary):** Significant population presence

2. **Important Statistics:**
   - o **45%** of leopards **live outside protected areas**
   - o **Melanistic leopards** found in **three forest divisions.**
   - o **State forest cover: 50%** of total geographic area

Conservation Challenges

1. **Poaching Concerns:**
   - o **59** leopard skins seized (2018-2023)
   - o **57** leopard skins recovered by STF (2019-2024)
   - o Total confirmed poaching: 116 leopards

2. **Protected Areas Network:**
   - o 1 National Park
   - o 19 Wildlife Sanctuaries
   - o 2 Conservation Reserves

How elephants are counted

Sub : Env

Sec: Species in news

Context:

- The Environment Ministry has delayed the release of the **"Status of Elephant in India 2022-23"** report, citing incomplete census data from the **Northeast**. The report for other regions is ready but will not be released until **June 2025**.

Decline in Elephant Populations:

- Preliminary data shows a **sharp decline** in elephant populations, particularly in:
  - o Southern West Bengal (**84%** decrease)
  - o Jharkhand (**64%** decrease)

- o Odisha (**54%** decrease)
- o Kerala (**51%** decrease)
- **Reasons for Decline**:
  - o The report attributes the decline to factors like **unmitigated mining**, **linear infrastructure projects**, and other **developmental activities**.

Counting Methods:
- The elephant census has evolved significantly since the 1990s:
- **Old Methods**:
  - o **Total Direct Count (Pre-2002)**: A basic **headcount of elephants,** which lacked scientific accuracy.
  - o **Indirect Dung Count (Post-2002)**: Surveyors counted elephant dung along pre-designated forest paths and used the **dung decay rate** and **defecation rate** to estimate populations.
  - o **Sample Block Counts**: Surveyed limited areas (**5 sq km**) to maximize detection and then extrapolated to estimate populations across larger areas.
- **New Method (2022-23 Census)**: The **2022-23 census** used a **genetic mark-recapture model**. Instead of visual identification (used for tigers), elephant dung samples were analyzed for **genetic markers** to identify individual elephants.

Mark-Recapture Method:
- This statistical method uses **recaptured individual photographs** (for tigers) or **dung DNA** (for elephants) to estimate **population density** and extrapolate numbers for areas not directly surveyed.
- The **Synchronous All India Elephant Estimation 2022-23 (SAIEE 2023)** differed from this **tiger census method** in only one aspect: it used a genetic mark-recapture model.
- The **elephant hide** has **no unique markings** like **tiger stripes.** So elephant dung samples collected during ground surveys were analysed in the lab to identify unique elepphants.

Tiger and Elephant Census Harmonization:
- In **2021, India** announced plans to harmonize **tiger and elephant population estimation**.
- In this method, the entire forest area is broken down into **similar-sized cells or blocks** (say, A, B, C, and D) where ground surveys are conducted to look for **tiger signs** (pug marks, droppings, etc.) and identify **tiger-occupied forest cells** (say, A, B and D).
- The survey also assesses a range of **"co-variates"** — common variable factors such as the **quality of vegetation, availability of prey. distance from water/ nightlight, degree of human disturbance etc.** - to determine the relative **tiger-holding potential of these blocks.**

Regional Threats:
- Habitat loss and conflict are common threats to elephants across India.
- Different regions face unique threats to elephants. For example, in **Odisha**, issues like **mining** and **low-hanging power lines** are key contributors to declining populations.

Brains and brawn
Sub: Env
Sec: Species in news
Halari Donkeys
- The **Halari donkey** is a beautiful and **endangered breed** found in the **Halar region of Gujarat.**
- **Fewer than 500 Halari donkeys remain,** making them a **rare** and **important** part of the **semi-arid landscapes** of **Jamnagar** and **Dwarka districts** in **Gujarat's Saurashtra region**.
- These **donkeys** are typically **white, larger,** and **more resilient than other breeds**.
- **Donkeys are intelligent**, **social animals** that form **close bonds with humans,** often supporting **transport needs.**

Uses:
- Locals recount stories of **Halari donkeys** being used to **build dams, forts, hilltop temples,** and **rest houses.** Their strength allows them to **carry heavy loads of stone and sand.**
- The **Bharwad** and **Rabari pastoralists** are the **main communities** that use this donkey as a pack animal to carry luggage during migration with small ruminants.
- The **Kumbhar (potter) community** also uses this animal for pottery work in the Jamnagar region.

Economic Value:

- The price of a **Halari donkey** exceeds **₹1 lakh** today, with rising demand across **India** for **Halari donkey dairies.**
- **Halari donkey milk** is prized for its **sweetness.** Its powdered form sells for more than **₹7,000 per kg** in **international markets,** particularly for cosmetic use.

Conservation Efforts

- The **Sahjeevan Trust,** in collaboration with **Gujarat's Animal Husbandry Department** and the **National Bureau of Animal Genetic Resources,** is working to conserve the **Halari breed**.
- **Pure-bred male and female Halari donkeys** have been identified for **breeding**, resulting in an increase in their numbers.
- They call for establishing **breeding farms** for **Halari donkeys** in their **native Halar region,** requiring more **substantial resources** from the State government.

Population of wild asses, an 'endangered species', has been rising since 1976 in Gujarat: State govt

Sub: Env

Sec: Species in news

Wild Ass Population in Gujarat (2024):

- The **wild ass population** in **Gujarat** has reached **7,672,** as per the **10th Wild Ass Population Estimation (WAPE)** conducted earlier this year.
- This marks a **26.14% increase** from the previous estimate in **2020,** when the population was **6,082.**
    - The **wild ass population** has been on an **upward trend** since **1976,** when the state **recorded only 720 wild asses.**
- **Methodology**:
    - **WAPE-2024** covered **15,510 square kilometers** and employed the **Direct Count Method**.
    - Enumerators received training in traditional methods and modern technology such as **drone cameras**, **camera traps**, and **forest modules**.

Population Distribution (WAPE 2024)

- **District-wise Breakdown:** Surendranagar: **2,705 wild asses,** Kutch: **1,993 wild asses,** Patan: **1,615 wild asses,** Banaskantha: **710 wild asses,** Morbi: **642 wild asses,** Ahmedabad: **7 wild asses.**
- **Categorization by Area**:
    - **Forest/Sanctuary Areas**: 2,569 female wild asses, 1,114 male wild asses, 584 baby wild asses, 2206 unclassified wild asses
    - **Revenue Areas**: 558 female wild asses, 190 male wild asses, 168 baby wild asses, 283 unclassified wild asses

Other Wildlife Enumerations (2024): Asian Antelope: 2,734, **Wild Boars**: 915, **Indian Hares**: 222, **Indian Gazelles**: 214, **Indian Jackals**: 153

About Indian Wild Ass (Equus hemionus khur):

- The Indian Wild Ass (**Indian onager** or, in the local Gujarati language, **Ghudkhur** and **Khur**) is a subspecies of Asiatic Wild Ass native to South Asia.

Physical Characteristics:

- Sandy-colored coat with darker mane
- Stands about 2-2.5 meters in length
- Distinctive upright mane and dark brown stripe along the back

Habitat & Distribution:

- Primarily found in the **Little Rann of Kutch, Gujarat, India**
- Prefers **arid and semi-arid grasslands** and **salt flats**
- The **Little Rann of Kutch Wild Ass Sanctuary** is their **main protected area**

Behavior:

- Lives in herds of varying sizes
- Males sometimes maintain territories
- Active during **early morning** and **late afternoon**
- Excellent runners, capable of reaching speeds up to **70 km/h**

Conservation Status:

- Listed as **Near Threatened** by IUCN

- Protected under **Schedule I of the Wildlife Protection Act**
- Main threats include **habitat loss** and **competition with livestock**

Historical Range:

- Historically, wild asses were found in **North-West India, Pakistan,** and **Central Asia**
- Now confined primarily to **Gujarat's Little Rann of Kutch.**

The Bishnoi, blackbuck and chinkara: What exactly were Guru Jambheshwar's principles regarding Thar wildlife?

Sub :Env

Sec: Species in news

Context:

- In **1998**, **Salman Khan, Saif Ali Khan,** and others allegedly hunted **blackbuck** in **Rajasthan's Kankani village,** triggering a legal battle and backlash from the **Bishnoi community,** known for zealously guarding the **wildlife** and environment of the **Thar Desert.**

Why Do the Bishnoi Protect Blackbuck and Chinkara?

- The **Bishnoi community,** mostly found in **western Rajasthan,** is based on **29 principles** set by *Guru Jambheshwarji* in **1485.** His teachings emphasized **protecting nature, especially wildlife and trees.**
- **Ecological Faith**:
  - Founded on the principle of compassion for all living beings, as reflected in rules like:
    - **Rule 19**: "Not to fell green trees."
    - **Rule 18**: "Be compassionate towards all living beings."
  - **Guru Jambheshwarji's teachings,** including the *120 shabdas* **(statements),** elaborate his philosophy, calling for **equality, modesty,** and **tolerance.**
- **Respect for Wildlife**:
  - The **Bishnoi** believe harming animals leads to a painful end, as reflected in **Shabad 09,** which warns against showing power over animals.
  - **Shabads 10, 44, 64,** and **85** further emphasize **kindness toward animals** and **denounce killing them for selfish reasons.**

Why Special Protection for Antelope?

- **Blackbuck, chinkara,** and other species are often found near **Bishnoi villages.** The community has historically protected wildlife like **blackbuck, chinkara,** and the **Great Indian Bustard,** as well as the **Khejri tree.**
- According to folklore, **Bishnoi** believes they may be reincarnated as **deer,** which explains the reverence for **blackbuck. Guru Jambheshwarji** is even said to have declared the **blackbuck** as a **manifestation of himself, reinforcing its sacred status.**

Historical and Modern Significance

- **Khejarli Massacre**: In **1730,363 Bishnoi** sacrificed their lives to protect **Khejri trees** from being cut down by **Maharaja Abhay Singh's soldiers.**
  - **Amrita Devi,** a **Bishnoi woman** was killed in **1730** while trying to protect a **grove of khejri trees.**
- The **Bishnoi community** has continued to defend the flora and fauna of the **Thar Desert,** even laying down their lives to protect wildlife from hunters and poachers.
- Understanding Bishnoi's deep ecological consciousness can offer valuable lessons in preserving the environment for future generations.

About chinkara and blackbuck:

Feature	Chinkara	Blackbuck
Scientific name	- Gazella bennettii	- Antilope cervicapra
Common names	- Indian gazelle, Ravine deer	- Indian antelope
Native range	- **India, Pakistan, Iran**	- **India, Nepal**
Habitat	- Grasslands, deserts, scrublands	- Grassy plains, open woodlands
Coat colour	- Light chestnut	- **Males:** black upperparts, white underparts - **Females:** fawn-coloured

Horn characteristics	• **Both sexes have horns,** Straight, ringed	• **Only males have horns** • Long, spiral-shaped
Diet	• **Herbivorous:** grasses, leaves, fruits	• **Herbivorous:** grasses, leaves
Social structure	• Small groups or solitary	• Herds; males often solitary
Conservation status	• **Least Concern (IUCN)** • **Protected** in India under **schedule 1** of WPA.	• **Near Threatened (IUCN)** • **Protected in India** under **schedule 1** of WPA. • **National animal of Pakistan**
Threats	• Habitat loss, hunting	• Habitat loss, hunting, agriculture
Unique features	• Adapted to arid conditions	• Capable of very high leaps

India will soon get a clear picture of its Ganges and Indus River dolphins: Centre

<u>**Sub :Env**</u>

<u>**Sec: Species in news**</u>

Context:

- **India** is set to get a clearer understanding of its **freshwater dolphins**—the **Ganges** and **Indus dolphins**—through an **8,000-kilometre aquatic survey.**
- The survey is the **world's first comprehensive assessment of dolphin populations** in the region.

Key Highlights:

- **Species Assessed**: **Ganges dolphin** (*Platanista gangetica*) and **Indus dolphin** (*Platanista minor*).
- It will establish a **baseline for dolphin populations**, aiding future conservation efforts.
- **Significance**: **River dolphins** are **indicators of a healthy river ecosystem.** However, their populations have been in **sharp decline** due to **pollution, habitat loss,** and **illegal hunting.**
- **Agencies Involved:** Union Ministry of Environment, Forest and Climate Change, WII, and state forest departments from Uttar Pradesh, Bihar, West Bengal, Assam, Madhya Pradesh, Rajasthan, and Punjab.
- **Conservation Goals:**
  - Formulate a detailed strategy for conserving river and marine dolphins.
  - Implement year-round monitoring of key dolphin habitats.

Decline of Dolphin Populations:

- **Historical Decline**: Populations of **Ganges** and **Indus dolphins** in **India's rivers** have **dropped** by **50-60%** over the last century.
- **Reasons**: Pollution, habitat destruction, reduced river flows, and illegal hunting (particularly for dolphin oil).
- **Local Extinctions**: **Dolphins** have disappeared from parts of the **Yamuna, Ken, Betwa,** and **Barak rivers.**

Conservation Priority:

- **Project Dolphin**: A key initiative, launched on August 15, 2020, aimed at securing the future of India's river dolphins.
- **Challenges**: Dolphins have a slow reproductive rate, typically producing one calf every 2-3 years, making their populations highly vulnerable to environmental threats and human activities.

About the Indus Dolphin and Ganges Dolphin:

Characteristic	Indus Dolphin	Ganges Dolphin
Scientific Name	• *Platanista minor*	• *Platanista gangetica*
Local Name	• **Bhulan** (in Pakistan and parts of India)	• **Susu** (in India, Bangladesh, Nepal)
Habitat	• **Indus River system** (primarily in Pakistan, a small section in the **Beas River, India**)	• **Ganges, Brahmaputra,** and **Meghna** river systems (India, Nepal, Bangladesh)
Conservation Status (IUCN)	• Endangered • **Schedule I,** Wildlife Protection Act (1972); State aquatic animal of Punjab	• Endangered • **Schedule I**, Wildlife Protection Act (1972); National aquatic animal of India and State aquatic animal of Assam

	• **Appendix I** of the Convention on International Trade in Endangered Species (CITES) and **Appendix II** of the Convention on Migratory Species (CMS COP)	• **Appendix I** of the Convention on International Trade in Endangered Species (CITES) and **Appendix II** of the Convention on Migratory Species (CMS COP)
Current Population	• ~1,816 in Pakistan; 6-8 in India (Beas River)	• ~2,644 in the Ganga basin; ~987 in Brahmaputra basin
Key Threats	• Habitat fragmentation, reduced river flow, pollution, illegal hunting	• Pollution, habitat destruction, reduced river flow, illegal hunting
Reproductive Rate	• Low (one calf every 2-3 years)	• Low (one calf every 2-3 years)
Conservation Challenges	• Severe habitat fragmentation due to dams, altered water flow, and very small population in India	• Pollution, illegal hunting for oil, habitat degradation, challenging to observe due to brief surfacing
Conservation Initiatives	• **Project Dolphin;** protected in a small section of **Beas River**	• **Project Dolphin;** year-round monitoring at key hotspots
Distinctive Features	• **Blind,** relies on echolocation to navigate; more isolated population	• **Blind,** uses echolocation; larger population, spread over more regions
Role as Ecosystem Indicator	• Indicates the health of the Indus River ecosystem	• Indicates the health of the Ganges and Brahmaputra River systems

Impact of Coastal Flooding on Tree Species: A Study on Resilience and Vulnerability

Sub : Env

Sec: Species in news

Why in News

A recent study published in the journal *Frontiers in Forests and Global Change* reveals that **different tree species react differently to coastal flooding,** highlighting the importance of **site-specific strategies for forest management.** The research provides insights into how **rising sea levels and changing climatic conditions impact coastal forests.**

Key Findings on Coastal Tree Species and Flooding

Tree growth is influenced by several factors such as **temperature, rainfall, soil conditions, and water availability.** Coastal trees have begun to **move inland to adapt to changing tides and salinity,** but this relocation can bring new challenges due to less favourable inland conditions.

The study shows that while some species like **American holly (Ilex opaca)** thrive under increased water levels, others like **loblolly pine (Pinus taeda)** and **pitch pine (Pinus rigida)** suffer from the effects of coastal flooding.

Methodology and Techniques Used

Dendrochronology: Researchers used this technique to study tree rings and establish a timeline of tree growth in response to environmental factors like temperature and flooding.

Dendrochronology, the **study of tree rings**, plays a **vital role** in understanding **historical mountain ecosystems**.

It helps determine the **age of trees** and analyze the **relationship** between **climate factors and tree growth**.

This method reveals whether a **treeline** is **static or shifting; older trees** at the upper boundary suggest a **static treeline,** while **younger trees** at higher elevations indicate a **moving treeline**.

The **correlation** of **annual tree ring widths** with **climatic data** from nearby stations enables researchers to identify **limiting climatic factors for tree growth,** such as **low rainfall leading to smaller rings**.

Figure labels: First year growth, Rainy season, Dry season, Scar from forest fire, Spring/early summer growth, Late summer/fall growth
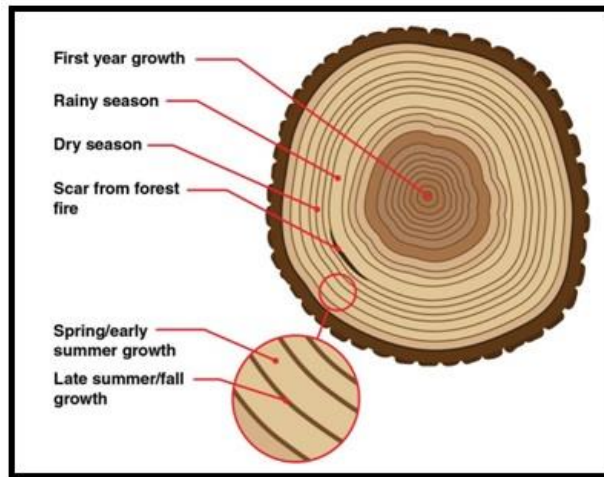
Gradient-Boosted Linear Regression: A **machine-learning model** was applied to understand **complex interactions between various climatic factors (e.g., sea-level rise, precipitation) and tree growth patterns.** This method allowed researchers to pinpoint how changes in conditions

Gradient-Boosted Linear Regression (GBLR) combines **linear regression with a boosting algorithm** to improve prediction accuracy.

It uses **multiple weak linear regression models,** each improving the performance of the previous model.

It is ideal for handling **multicollinearity and modelling interactions** between **independent variables.**

GBLR is applied in **environmental studies, finance, and other fields** requiring high-precision regression modelling.

Implications for Forest Management

Forest managers can assess the **vulnerability of coastal forests by cataloguing tree species and site-specific conditions,** ensuring that species at higher risk are prioritized for conservation efforts.

With **sea levels rising at a rate that has doubled since 1993,** and projections of a **threefold increase in coastal floods by 2050,** managing coastal forests requires targeted, location-specific strategies.

More than **3 billion people** rely on coastal ecosystems for livelihoods, making the conservation of coastal vegetation critical as rising sea levels threaten these environments.

The findings advocate for a tailored approach in managing coastal forests, taking into account not only rising sea levels but also local weather and soil conditions that affect tree resilience.

Reckless disregard

Sub : Env

Sec: Species in news

Context:

- **India** is set to expand **seaweed cultivation** along its coastline by promoting **Kappaphycus alvarezii,** a known **invasive species** that has smothered **coral reefs** in the **Gulf of Mannar** over the past two decades.

About Kappaphycus alvarezii:

- **Kappaphycus alvarezii** is a known **invasive species** that has already caused damage to coral reefs in **Tamil Nadu's Gulf of Mannar**, where it was introduced for commercial cultivation two decades ago. Though valuable for producing **carrageenan** (an emulsifier used in foods, beverages, and medicines) and **biostimulants** (which enhance crop yields), its spread threatens local ecosystems.

- It's also known as **elkhorn sea moss** or **cottonii.**

- It's a large, robust seaweed that can grow up to 2 meters in length. It has a branching thallus structure and can vary in colour from greenish-brown to red to yellow.

- **Habitat:** Naturally occurs in tropical marine waters, particularly in the Indo-Pacific region.

- **Economic importance:**

  - Major source of carrageenan, a widely used food additive and industrial polymer

  - Extensively cultivated in many tropical countries for commercial purposes

- Cultivation:

  - One of the most important commercially cultivated seaweeds globally

  - Relatively fast-growing and can be harvested every 6-8 weeks

- **Uses:**
  - Food industry: As a source of carrageenan for thickening and stabilizing foods
  - Cosmetics: In various skincare and haircare products
  - Pharmaceuticals: As an excipient in drug formulations
  - Agriculture: As a bio-fertilizer and soil conditioner
- **Environmental concerns:**
  - In some areas where it's been introduced for cultivation, it has become invasive
  - Can potentially outcompete native species and alter marine ecosystems

Long live the King Cobra(s): Scientists recategorize world's longest venomous snakes into 4 distinct species, with one from the Western Ghats

Sub: Envi

Sec: Species

Context:

- The **king cobra**, previously considered one species, has been reclassified into **four distinct species** across various regions: Mainland Asia, Maritime Southeast Asia, The Western Ghats of India, Luzon Island, Philippines

Key Discoveries:

- In **2021**, the team identified **four geographically separate lineages,** termed as **"confirmed candidate species (CCS)."**
  - Endemic Western Ghats lineage (India)
  - Widespread Asian mainland lineage (northern/eastern India, China, Thailand)
  - Malesian lineage (Malay Peninsula, Greater Sunda Islands, parts of the Philippines)
  - Isolated Luzon Island lineage (Philippines)

Four New King Cobra Species:

1. **Northern King Cobra (*Ophiophagus hannah*)**
   - Found in:
     - Northern India, Nepal, Bhutan, Tibet
     - Eastern India, China, Myanmar, and parts of Southeast Asia
   - The type locality is Shibpur, near Kolkata, India.
2. **Sunda King Cobra (*Ophiophagus bungarus*)**
   - **Inhabits:**
     - Southern Thailand, West Malaysia, Singapore
     - Sumatra, Borneo, Java, Bali, southern Philippines
   - Named due to similarities with **kraits** (genus *Bungarus*), possibly in morphology or behaviour.
3. **Western Ghats King Cobra (*Ophiophagus kaalinga*)**
   - Found in the **Western Ghats** of India (Tamil Nadu, Kerala, Karnataka, Goa, and parts of Maharashtra).
   - Prefers **mid-elevation rainforests** but can be found from low foothills to high-elevation montane forests.
   - The name *kaalinga* comes from **Kannada,** referencing the **snake's dark colour.**
4. **Luzon King Cobra (*Ophiophagus salvatana*):**
   - Exclusive to **Luzon Island** in the **northern Philippines.**
   - Named after the local **Tagalog** name for the **king cobra.**

Taxonomic Revision and its implication:

- The study presents a formal revision of the **genus *Ophiophagus*,** describing two new species.
- The new classification has implications for:
  - **Snakebite management**
    - King cobra bites, though rare, can be fatal due to potent neurotoxic venom.
    - The new taxonomy could help in improving treatments for snakebites, as venom compositions may differ between species.
  - **Species conservation**
    - Western Ghats and Luzon king cobras are of particular concern due to their restricted habitats, which are biodiversity hotspots.
    - Threats include habitat destruction, poaching, and fear-driven killings.

o **Future research**

About the King Cobra:

- They are the world's longest venomous snake.
- **First Classification (1836)**: Danish zoologist **Theodore Edward Cantor** named the **king cobra.**
- **Scientific Name**: *Ophiophagus hannah*
    o ***Ophiophagus*:** Derived from Greek, meaning **"snake-eater"** (*ophis* for snake, *phagos* for eater).
- It preys chiefly on other snakes and occasionally on some other vertebrates, such as **lizards** and **rodents.**
- It is a **highly venomous** and **dangerous snake** when agitated or provoked that has a fearsome reputation in its range, although it is typically shy and avoids confrontation with humans when possible.
- The king cobra is a prominent symbol in the mythology and folk traditions of India, Sri Lanka and Myanmar.
- It is the national reptile of India.
- It is threatened by habitat destruction and has been listed as **Vulnerable** on the **IUCN Red List since 2010.**
- In Southeast Asia, the **king cobra** is threatened foremost by **habitat destruction** owing to deforestation and expansion of agricultural land.
- It is also threatened by poaching for its **meat, skin** and for use in **traditional Chinese medicine.**
- The king cobra is listed in **CITES Appendix II.**
- It is protected in **China** and **Vietnam.**
- In India, it is placed under **Schedule II** of **Wildlife Protection Act, 1972.**
- Killing a king cobra is punished with imprisonment of up to **six years.**

Farmed salmon is endangering access to local fishes for poorer communities, warns study

Sub : Env

Sec: Species in news

Context:

- **Impact of Farmed Salmon Demand on Coastal Communities and Fisheries**
  Study published in Science Advances, October 16, 2024.

Key Findings:

- The increasing demand for **farmed salmon** is impacting **global coastal communities** by limiting their access to **affordable local fish** like **sardines** and **anchovies.** These small fish are often diverted to produce **fishmeal and fish oil (FMFO),** primarily used as **feed for farmed fish.**
- **Implications for Coastal Communities:**
    o **Local Deprivation**: Many **reduction fisheries** operate in **poor coastal regions,** depriving communities of fish that are crucial for their sustenance and livelihoods.
    o **Global Impact**: This raises concerns about the sustainability of the **aquaculture industry**'s dependence on **FMFO**, especially in regions heavily reliant on small pelagic fish.
- **Fish-In-Fish-Out (FIFO) Ratio:**
    o **Industry Practices**: The study critiques the misleading use of the **FIFO ratio,** which measures how much wild fish is needed to produce **farmed fish.** By averaging feed inputs for herbivores and carnivores, the ratio conceals the high feed demands of carnivorous fish like salmon.
    o **Rising Demand for Fish Oil**: **Fish oil** is a limited resource, heavily used in **salmon farming.** In **2020, farmed Atlantic salmon** alone accounted for **60%** of global fish oil consumption, with salmon farms now supplying **70%** of the world's salmon.

Challenges Ahead:

- **Climate Change**: Fish populations, including **Peruvian anchoveta**, are **declining** due to climate change, particularly in warmer waters where fish contain less oil.
- **Overfishing Juveniles**: **Poor fisheries management** is leading to **higher juvenile fish catches,** which **reduces oil yields** and threatens stock sustainability.

Reduction Fisheries:

- **Reduction fisheries** are **fisheries** that **"reduce,"** or process their catch, into **fishmeal and fish oil.** They rely largely on **small and medium-sized pelagic species;** that is, fish found in the upper layers of the open sea, such as **menhaden, anchovies,** and **sardines.**
- **12** of the **top 20 global fisheries (by volume)** are **reduction fisheries,** where fish are processed into **FMFO.**

- These fisheries exploit forage fish such as **anchovies** and **sardines**, which make up **26%** of global fish catches by volume.
- The largest reduction fishery, by far, is that for **Peruvian anchoveta.** The catch from some fisheries, such as the **anchoveta in Peru** or **Gulf menhaden** in **the US** are almost exclusively used for **reduction purposes.**

Salmon:
- **Salmon** is a **common food fish** classified as an **oily fish** with a **rich content of protein** and **omega-3 fatty acids.**
- **Norway** is a major producer of **farmed and wild salmon,** accounting for more than **50%** of **global salmon production.**
- **Farmed** and **wild salmon** differ only slightly in terms of **food quality and safety**, with **farmed salmon** having **lower content of environmental contaminants** and **wild salmon** having a **higher content of omega-3 fatty acids.**

Sardines:
- **Sardines** ("pilchards") are a **nutrient-rich, small, oily fish** widely consumed by humans and as **forage fish** by **larger fish species, seabirds** and **marine mammals.**
- Sardines are a source of **omega-3 fatty acids.**

Peruvian anchoveta:
- The **Peruvian anchoveta** (Engraulis ringens) is a species of fish of the **anchovy family, Engraulidae**, from the **Southeast Pacific Ocean.**
- It is one of the most commercially important fish species in the world, with annual harvests varying between **3.14 and 8.32 million tonnes** from **2010 to 2021**.

Fungi may get its own taxonomical kingdom named 'funga' for conservation purposes
Sub : Env

Sec: Species in news

Context: Fungi May Get Their Own Taxonomical Kingdom: **'Funga'**

Proposal for Recognition:
- **Chile** and the **United Kingdom** are preparing a proposal to establish a **new taxonomical kingdom, "Funga,"** for **fungi** (mushrooms, moulds, yeast, lichen, and mildew).
- The proposal will be presented at the **UN Convention on Biological Diversity (CBD)** during the **COP16** in **Cali, Colombia** starting on **October 21, 2024**.

Key Points:
- **Fungi's Role**:
  o **Fungi** are essential for **ecological processes** like **decomposition** and **forest regeneration.**
  o They are critical for **human food production** (bread, cheese, wine, beer, chocolate).
  o Fungi play a major role in **climate change mitigation** and **wildlife conservation** by regulating carbon dioxide levels and cleaning polluted soils.
- **Neglect in Conservation**:
  o **Fungi** have historically been excluded from conservation strategies, despite their importance.
  o The **International Union for Conservation of Nature (IUCN)** noted that no life on Earth is possible without fungi.
- **Understudied**:
  o It is estimated that only **8% of the 2.2–3.8 million fungal species** have been scientifically identified, with around 2,000 new species discovered annually.

Fungal Threats:
- **Environmental Threats**:
  o Deforestation, climate change, pollution, and widespread use of fungicides impact fungi significantly.
  o **Overharvesting** and **nitrogen enrichment** also pose threats to fungal populations.
- **Fungi and Climate Change**:
  o Fungi, particularly those in **boreal forests**, absorb large amounts of carbon through their symbiotic relationship with plant roots.
  o They can serve as a sustainable food source, potentially reducing deforestation driven by cattle ranching and soy farming.

Global Significance:
- If adopted, **funga** will join **flora** and **fauna** as one of the three recognized kingdoms of life: **plants, animals,** and **fungi.**

In **2021**, **the International Union for the Conservation of Nature Species Survival Commission (IUCN SSC) and IUCN Rewild** became the first organizations to recognize fungi as a separate kingdom of life.

7. Antelope like Blackbuck and Gazelle like Chinkara are not 'deer'; know the difference

Sub : Env

Sec: Species in news

Context:

- There is frequent confusion between **antelope** and **deer** in Indian media. Despite their similar appearances, the two belong to distinct **taxonomic families.**

Taxonomy:

- Both **deer** and **antelope** are part of the **Kingdom Animalia** and belong to the **Artiodactyla** order, meaning they are **even-toed ungulates** (hooved animals).
- **Deer** belong to the **Cervidae** family, while **antelope** falls under the **Bovidae** family, which also includes **cattle, sheep, and goats.**
- Other members of the **Artiodactyla order** include **pigs, giraffes, camels,** and **alpacas.**
- **Perissodactyla** (odd-toed ungulates), on the other hand, includes **horses, rhinoceroses, and tapirs,** which bear weight on one or three toes.

Key Differences:

- **Antlers vs. Horns**:
  - **Deer** have **antlers** that are branched and shed annually, present **only in males.**
  - **Antelope** have **horns**, which are permanent, unbranched, and **do not shed.**

Distribution and Diversity:

- **Antelope**:
  - **Africa** is the primary haven for **antelopes**, home to **91 species**.
  - **Antelopes** inhabit a wide range of environments, from **forests to savannahs, deserts,** and **even semi-aquatic habitats.**
  - **India** has **six species** of **antelope**, including the **Blackbuck** and **Chinkara**.
- **Deer**:
  - There are **43** species of deer worldwide, ranging from the tiny **Pudu** in South America to the largest **Moose** in North America.
  - India has **12 species** of **deer,** including the **Sambar** and **Indian Mouse Deer**.

Three scientists discover new genus of jumping spiders 'Tenkana' in South India

Sub : Env

Sec: Species in news

Context:

- A team of arachnologists has discovered a **new genus of jumping spiders**, named **Tenkana**, which is found across southern India. It also introduced a new species, **Tenkana jayamangali**, identified in Karnataka.
- The research was conducted by a collaborative team from various institutions in India and Canada and findings published in the journal **Zookeys**.

Tenkana spiders' Habitat:

- Unlike related species that typically inhabit forest environments, Tenkana spiders are **adapted to drier areas and ground habitats**.
- Their presence has been confirmed in several regions, including Tamil Nadu, Puducherry, Karnataka, Telangana, and Andhra Pradesh.

Etymology:

- The name **Tenkana** is derived from the Kannada word for "south," signifying that all identified species are endemic to **southern India and northern Sri Lanka**.
- The newly identified Tenkana jayamangali has been named after the **Jayamangali river in Karnataka.**

Taxonomy and Classification:

- Tenkana belongs to the **Plexippina subtribe** of jumping spiders. It is distinct from related genera such as **Hyllus** and **Telamonia**.

Research Methodology:

- The research team utilized both **genetic studies and physical examinations** to establish the characteristics of the new genus.

Species Classification

- The newly established genus **Tenkana** incorporates two species that were previously classified under the genus **Colopsus**:
- **Tenkana manu**: Found in southern India and Sri Lanka, named after retired professor Dr. Manu Thomas in 2014.
- **Tenkana arkavathi**: Identified in Karnataka.

The right to die with dignity — SC rulings and what the law says in India

Sub : Env

Sec: Species in news

Context:

- Last month, the **Ministry of Health and Family Welfare** released **draft Guidelines for the Withdrawal of Life Support in Terminally ill patients** to operationalise the Supreme Court's 2018 and 2023 orders on the right to die with dignity for all Indians.

Withholding/ withdrawing life-sustaining treatment:

- Life-sustaining treatments are medical treatments that **artificially replace bodily functions** essential to the life of the person.
- Withholding or withdrawing life-sustaining treatment refers to **discontinuing life-sustaining medical interventions** such as **ventilators and feeding tubes**, etc., when these no longer help the condition of the patient or prolong their suffering.
- Withholding or withdrawing life-sustaining treatment is not about giving up on the patient. It involves recognizing when further medical intervention would only prolong suffering. Instead, it allows for **palliative care**, focusing on managing pain and ensuring comfort.
- Withholding or stopping life-sustaining treatment can happen in two ways:
  o When a patient who can make decisions chooses to refuse treatment
  o Through an **advance medical directive (living will),** a document that outlines what should be done if the person is unable to make their own medical choices in the future.
- For someone who can't make decisions and doesn't have a living will, doctors can consider stopping treatment when they believe there's no reasonable chance of recovery from a terminal illness or a vegetative state.
- The withholding or withdrawal of life-sustaining treatment also includes '**do-not-attempt-resuscitation**' orders.
- When a do-not-attempt-resuscitation (DNAR) order is in place, doctors should still work to treat the patient's underlying condition. The order only means that they will not start resuscitation efforts.

Legal status:

- The right to refuse medical treatment has long been recognized in common law, even if such a decision may lead to death.
- Following the Supreme Court's decision in **Common Cause vs Union of India (2018)**, it is also recognised as a fundamental right under **Article 21** of the Constitution.

What is Euthanasia:

- Euthanasia, often referred to as **mercy killing**, is the **intentional act of a doctor ending the life of a terminally ill patient** for the good of the patient.
- **Passive Euthanasia**: In India, the term passive euthanasia is used to describe withholding or withdrawing life-sustaining treatment.

How to create a Living will:

- To ensure the right to die with dignity, the Supreme Court established a framework for living wills in 2018, which was simplified in 2023.
- A living will is a written document created by anyone **aged 18 or older**, outlining their treatment preferences if they lose decision-making capacity.
- It should include **at least two trusted surrogate decision-makers** (e.g., family or friends) to make choices on the person's behalf.
- Must be **signed in front of an executor and two witnesses**, and attested by a notary or gazetted officer to be legally valid.

Medical Procedure for Withholding or Withdrawing Treatment:

- **Primary Medical Board:** The treating hospital forms a board to evaluate the patient's condition and recommend whether to withhold or withdraw treatment. This board includes the treating doctor and two subject-matter experts with at least five years of experience.
- **Secondary Medical Board:** This board, also set up by the hospital, reviews the Primary Board's decision and consists of a a registered medical practitioner nominated by the district Chief Medical Officer, along with two subject-matter experts with at least five years of experience. All these members must be different from those on the Primary Medical Board.
- **Consent Requirement:** Consent from the nominated decision-makers in the living will or surrogate decision-makers is required to proceed with withholding or withdrawing treatment.
- **Judicial Notification:** The hospital must inform the local judicial magistrate about decisions made regarding treatment.

Just 150 left, glimmer of hope for great Indian bustard after first-ever artificial insemination birth in Jaisalmer

Sub : Env

Sec: Species in news

Context:

- A **Great Indian Bustard (GIB) chick** was born on October 16 at the **Sudasari Great Indian Bustard Breeding Centre in Rajasthan,** marking the **first successful use of artificial insemination** for this **critically endangered species.**
- Authorities view this as a crucial advancement in GIB conservation efforts.
- **Conservation Background and Efforts**:
    o The **GIB**, found **only in India and primarily in Rajasthan**, has a population of fewer than **150 birds**.
    o Conservation efforts include a **captive breeding program** led by the **Centre**, the **Rajasthan government,** and the **Wildlife Institute of India (WII).**
    o A team from **WII** learned **artificial insemination** techniques in **Abu Dhabi**, where similar methods are used for the **houbara bustard**.
- **Legal and Environmental Challenges**:
    o In **2021**, the **Supreme Court** ordered that **power lines** in **GIB habitats** be buried underground.
    o However, this order was reviewed in **2023** due to logistical challenges in implementing it over long distances.
- **Future of the Captive Breeding Project**:
    o Experts caution that while artificial insemination is a positive development, its impact on **GIB population recovery** will take time.
    o **GIB's Unique Breeding Challenges**:
        ▪ Each **GIB** lays just **one egg annually,** which is **roughly the size of three chicken eggs.**
        ▪ **Eggs** are laid on **ground nests,** making them vulnerable to **predators.**
        ▪ It takes **two years to raise a chick** before laying another egg.

What is the Great Indian Bustard?

- One of the **heaviest flying birds endemic to the Indian subcontinent.**
- **State Bird** of Rajasthan.

Habitat:

- Untamed, Arid grasslands.
- Among the heaviest birds with flight, **GIBs** prefer **grasslands** as their habitats
- A Maximum number of GIBs were found in Jaisalmer and the Indian Army-controlled field firing range near Pokhran, Rajasthan.
- Other areas: Gujarat, Maharashtra, Karnataka and Andhra Pradesh.

Population:

- As per the studies conducted by the **Wildlife Institute of India,** there are around **150 Great Indian Bustards** left across the country which includes about **128 birds in Rajasthan** and **less than 10 birds** each in the States of **Gujarat, Maharashtra, Andhra Pradesh** and **Karnataka.**
- While the **GIBs' historic range** included much of the **Indian sub-continent,** it has now **shrunk to just 10 per cent** of that.

Protection Status:

- **IUCN Status:** Critically Endangered.
- Listed in **Wildlife Protection Act**'s Schedule 1.

Threats to the GIB:

- The population has declined due to:
  - Increased human activity in their habitats.
  - Predation on eggs by other animals.
  - Deaths from collisions with overhead power lines.
- A 2020 study by WII estimated that power lines in and around the 4,200-sq-km Desert National Park kill approximately 84,000 birds annually, including the GIB.

Significance of GIBs in the ecosystem-

- Terrestrial birds spend most of their time on the ground, feeding on insects, lizards, grass seeds, etc. **GIBs** are considered the **flagship bird species of grassland** and hence **barometers of the health of grassland ecosystems.**

Why is the Great Indian Bustard endangered?

- Among the **biggest threats** to the **GIBs** are **overhead power transmission lines.**
- Due to their **poor frontal vision,** the birds **can't spot the power lines** from a distance, and are too heavy to change course when close. Thus, they collide with the cables and die.
- According to the **Wildlife Institute of India (WII)**, in Rajasthan, **18 GIBs** die every year after colliding with overhead power lines.

Geography

Coastal Erosion in Brazil: A Growing Crisis Due to Rising Atlantic Waters

Sub : Geo

Sec: Climatology

Why in News

The **coastal erosion** along **Brazil's Atlantic shoreline** has intensified, with the **Atlantic Ocean advancing inland** at an alarming rate. **In 2023, saltwater intrusion reached areas as far as 150 km inland,** particularly impacting communities near the **Amazon River.** The consequences of climate change, rising sea levels, and weakened river systems have caused destruction to coastal towns, threatening both local livelihoods and ecosystems.

Impact of Climate Change on Brazil's Coastline

Case of Atafona, Rio de Janeiro: The coastal town of **Atafona, north of Rio de Janeiro,** has seen severe coastal erosion due to a combination of climate change and natural factors.

Rising sea levels and the silting of the **Paraíba River** have resulted in the destruction of over 500 homes, including a four-story building.

Rising Sea Levels in the Region: The **United Nations report, "Surging Seas in a Warming World,"** states that sea levels around Atafona have risen by 13 cm in the last 30 years. By 2050, this region could see an additional 16 cm rise in sea levels, leading to further erosion and displacement.

Coastal areas like Atafona could see the ocean advance inland by 150 meters within the next 28 years. This is primarily due to **the lack of sediment carried by the Paraíba River,** which previously helped maintain beach formations.

Ponta Negra Beach Erosion: Ponta Negra, a popular seaside resort in northeastern Brazil, has **lost 15 meters of white sand over** the past two decades.

Accelerating Sea Level Rise: The **Intergovernmental Panel on Climate Change (IPCC)** has reported that sea levels are rising at an accelerated rate, with the current increase rate at 0.48 cm per year, more than double that of the previous decade (0.21 cm annually in 1993-2002).

About Brazil:

Geography	Largest country in South America 5th largest country in the world by area Borders 10 out of 12 South American countries, except Chile and Ecuador
Bordering Countries	Argentina, Bolivia, Colombia, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela, French Guiana (an overseas department of France)
Population	Over 210 million people (2023 estimate) The most populous country in South America **6th most populous country globally**
Economy	**Largest economy** in Latin America **9th largest** economy worldwide by nominal GDP

	Part of the **BRICS group** (Brazil, Russia, India, China, South Africa) Founding member of **Mercosur** (Southern Common Market)
Natural Resources	Home to the majority of the **Amazon rainforest (60%).** Rich in minerals, including **iron ore** and **gold** Major producer of **coffee, soybeans,** and **sugarcane**

Paraíba River

The **Paraíba do Norte River,** also known as **Parahyba do Norte**, originates from the **Borborema Plateau in the state of Paraíba, Brazil.** The river is approximately **380 kilometers long.**

Some of its important tributaries include the **Mamanguape River.** It drains water into the **Atlantic Ocean near the capital of Paraíba state, João Pessoa.**

The river runs through the **state of Paraíba** and is a **crucial waterway for agriculture, particularly sugarcane cultivation,** which was historically significant to the economy of northeastern Brazil.

"Surging Seas in a Warming World" (2024) report:

Released by: United Nations (2024).

Key Concern: Accelerating sea-level rise due to global warming.

Current Rate: Sea levels are rising at **0.48 cm per year**, more than double the rate in the 1990s.

Projection: By **2100**, sea levels could rise by **up to 1 meter** if high emissions persist.

Affected Population: Over **600 million** people living in coastal zones globally are at risk.

Key Impact Areas: Low-lying islands, coastal cities, ecosystems (e.g., mangroves, coral reefs).

The Rapid Intensification of Hurricane Milton

Sub: Geo

Sec: Climatology

Why in News

Hurricane Milton, which made landfall near **Siesta Key in Florida,** caused widespread devastation including **intense rainfall, flooding, and tornadoes.** Despite its unusual characteristics, the rapid intensification of the storm is seen as part of a broader pattern linked to climate change. The event highlights growing concerns over the increasing frequency of extreme weather events due to global warming.

What is Hurricane:

- A hurricane is a powerful and destructive **tropical storm** characterized by strong winds, heavy rainfall, and low **atmospheric pressure.**
- Hurricanes are also known as **cyclones or typhoons** in different parts of the world.
- In the **Atlantic Ocean and Northeast Pacific**, they are called hurricanes, while in the north western Pacific, they are referred to as typhoons, and in the South Pacific and Indian Ocean, they are known as cyclones.

Key characteristics of hurricanes:

- **Low Pressure Centre:** Hurricanes have a **well-defined centre** of low atmospheric pressure, known as the
- The eye is typically calm and clear, with light winds, surrounded by a **ring of intense thunderstorms** called the eyewall.
- **Strong Winds:** Hurricanes are known for their powerful winds that can reach sustained speeds of at least 74 miles per hour or higher.
- **Heavy Rainfall:** Hurricanes produce heavy rainfall, which can lead to **flooding, landslides, and storm surges.**

Formation:

- Hurricanes form over **warm ocean waters** when the sea surface temperature is typically **above 26 degrees Celsius**.
- **Warm, moist air** rises from the **ocean's surface,** creating an area of low pressure.
- As the **air cools and condenses,** it releases heat, which fuels the storm's development.

Categories:

- Hurricanes are categorized on the **Saffir-Simpson Hurricane Wind Scale** based on their **maximum sustained wind speeds**.
- The scale ranges from **Category 1 (weakest: 74-95 mph) to Category 5 (strongest: 157 mph and higher)**, with each category representing a higher wind speed and potential for damage.

Factors Behind Milton's Intensification

- **Ocean Heat**: **Sea surface temperatures in the western Gulf of Mexico** reached nearly 31°C, well above the 26°C threshold necessary for hurricane development. **Warmer water evaporates more quickly,** fuelling the storm's rapid intensification.
- **Climate Change Link**: **The rising sea temperatures in the Gulf are primarily attributed to climate change**. Since 1850, global sea surface temperatures have increased by nearly 0.9°C, with around 0.6°C of this rise occurring over the last 40 years.
- **Moisture Content**: For **every 1°C rise in temperature, the atmosphere can hold 7% more moisture,** contributing to more intense storms. This increased moisture leads to heavier rainfall and stronger storms.
- **Wind Shear Impact**: **Wind shear can disrupt hurricanes by altering wind speed and direction.** In Milton's case, the lack of wind shear allowed the storm to intensify rapidly without interference.

Wayanad's New X-Band Radar: Enhancing Weather Monitoring and Forecasting in India

Sub : Geo

Sec : Climatology

Why in News

In **July 2024,** heavy rainfall led to devastating floods and landslides in **Kerala's Wayanad district,** causing over 200 fatalities. To improve disaster preparedness and **early warning systems,** the Union Ministry of Earth Sciences approved the **installation of an X-band radar in Wayanad** to monitor weather conditions and soil movements, which are crucial for landslide detection.

What is RADAR?

RADAR is the expansion for **Radio, Detection and Ranging.**

Its **basic components** are a transmitter, receiver, antenna, power supply system, signal processing and high computing devices.

It w**orks on the principle of electromagnetic waves** sent out by the transmitter.

The same wave that strikes an object/dense medium is reflected back to the receiver.

The distance up to the object is determined based on the speed of the electromagnetic wave, and the time to travel to the object and back.

There are **at least ten types of radars.**

Ground Penetrating Radar: It studies the **Earth's crust up to 9-metre in depth**.

It is being used by the **Defence Geoinformatics Research Establishment (DGRE)** at **Joshimath.**

InSAR (Interferometric Synthetic Aperture Radar)

It makes **high-density measurements** over large areas by using radar signals from **Earth-orbiting satellites** and measures changes in land surface.

It is also being used in **Joshimath** and other parts of Uttarakhand.

History of Radar Use in India: India began using radar for **meteorological purposes in the 1950s.**

The first indigenously designed **X-band radar was installed in 1970 in New Delhi.**

In the 1990s, the Indian Meteorological Department (IMD) upgraded outdated X-band radars with digital systems. **India uses both X-band and S-band radars for weather detection**, with the **S-band radar being preferred for long-range cyclone detection.**

Expansion of Radar Infrastructure: In **September 2024**, the Union Cabinet approved a **₹2,000-crore 'Mission Mausam'**, aiming to install up to 60 new meteorological radars by 2026, enhancing weather forecasting capabilities.

Doppler radar:

A **Doppler Radar** is a specialised radar that uses the **Doppler effect** to produce velocity data about objects at a distance.
- When the source and the signal are in relative motion to each other, there is a change in the frequency observed by the observer. This is called the **Doppler effect.**
- If they are moving closer, the frequency increases and vice versa.

A **Doppler Weather Radar (DWR)** works on the **Doppler principle.**
- It is designed to improve precision in long-range weather forecasting and surveillance using a **parabolic dish antenna** and a **foam sandwich spherical radome.**

DWR has the equipment to **measure rainfall intensity, wind shear and velocity** and **locate a storm centre** and the **direction of a tornado or gust front.**

Why DWR is considered superior to other radars?

Unlike others, a **DWR** has the **ability to detect air motion, wind, speed of wind, rains, temperature, thunderstorms, hail, squalls, lightning, cyclones and cloud movements and volumetric analysis of cloud and reflectivity index,** among others.

It costs approximately ₹10-20 crore per unit.

The **National Ocean and Atmospheric Administration (NOAA)** of the **US** uses **148** of them.

The **Indian Army and Air Force** have deployed the **Indian Doppler Radar (INDRA)** for the **detection of aircraft and other objects in the air.**

What is an X-Band Radar?

An **X-band radar** operates in the **8-12 GHz frequency range (wavelengths of 2-4 cm).** This **shorter wavelength allows for high-resolution imagery,** making it ideal for detecting smaller objects such as rain droplets and fog. However, because higher frequencies attenuate more quickly, X-band radars have a shorter range compared to lower-frequency radars.

Why Does Wayanad Need an X-Band Radar?

Wayanad is prone to **landslides and floods**, as demonstrated by the July 2024 disaster. The **X-band radar will play a crucial role in monitoring soil and particle movements, providing early warnings for landslides,** and improving overall disaster preparedness in the region. Additionally, the radar will complement existing weather forecasting infrastructure by providing localized, high-resolution data.

NISAR: A Joint Initiative by NASA and ISRO

The **NASA-ISRO Synthetic Aperture Radar (NISAR)** is a satellite designed to monitor Earth's land masses using radar imaging. Its payload will consist of an **L-band radar built by NASA and an S-band radar developed by ISRO.** The satellite will track and provide data on natural processes, including soil displacement, landslides, and changes in vegetation.

The **NISAR satellite** is set to launch in **2025 on an ISRO GSLV Mk II rocket,** with an estimated cost of **$1.5 billion**, **largely funded by NASA.** This satellite will contribute to global environmental monitoring efforts and disaster management.

The U.S. will contribute the large deployable antenna.

It is a **dual band polarisable radar.**

Benefits of NISAR:

- It has a large deployable antenna with an **18-meter diameter, it has a very high swath.**
- It can **fully cover the earth in approximately 14 to 15 days, in radar.** It can monitor various aspects in very high resolution.
- It can monitor the tectonic movements to **centimetre accuracy.**
- It can accurately measure water bodies.
- It can look at water stressing on the earth, wherever there is deficiency of water.
- It can ground-penetrate to a certain depth. It is capable of monitoring the vegetation cover and snow cover

Tamil Nadu rains due to depression, onset of Northeast and withdrawal of Southwest monsoon

Sub: Geo

Sec: Climatology

Context:

- **Tamil Nadu,** particularly Chennai, has been experiencing **heavy rainfall** since October 14, with predictions of continued downpours in the coming days. The primary causes are a **low-pressure area** off the **Tamil Nadu coast,** the **onset of the Northeast monsoon,** and the **sudden withdrawal of the Southwest monsoon** on October 15.

Meteorological Factors for heavy rainfall:

- **Low-Pressure Area**:
    - As of October 15, a well-marked **low-pressure area** was observed in the **central Bay of Bengal,** which is expected to intensify into a **depression** and move towards **northern Tamil Nadu, Puducherry,** and **southern Andhra Pradesh** in the next 24-48 hours.
- **Cyclonic Circulation**:
    - A **cyclonic circulation** off the coast of **Andhra Pradesh** in the **west-central Bay of Bengal** is also contributing to the rainfall.
- **Northeast Monsoon Onset**:
    - The **IMD** declared the **onset of the Northeast monsoon,** which is the **main rainfall season for Tamil Nadu and southern states like Kerala, Andhra Pradesh, and Karnataka.** The conditions for its onset include **easterly and northeasterly winds** and **ongoing rainfall in southern Peninsular India.**
- **Southwest Monsoon Withdrawal**:
    - The **complete withdrawal of the Southwest monsoon,** initially expected to occur over several days, was completed on October 15, coinciding with the typical withdrawal date.

About Northeast Monsoon:

- The **Northeast monsoon** marks the **rainy season** for the **southern states of India,** primarily affecting **Tamil Nadu, Kerala, Andhra Pradesh, Karnataka,** and the **Union Territory of Puducherry.**
- It typically begins in **mid-October** and lasts until **December**.
- Unlike the **Southwest monsoon**, which delivers **rain across most of India**, the **Northeast monsoon** is critical for the **southeastern part of the country.**

Key Features of the Northeast Monsoon:

- **Onset Timing**:
  - The **Northeast monsoon** usually begins in the **second half of October,** around the time the **Southwest monsoon withdraws** from the **Indian subcontinent.**
  - The onset is marked by the establishment of **easterly and northeasterly winds** over southern India and the Bay of Bengal.
- **Main Rainfall Region**:
  - **Tamil Nadu** receives around **48%** to **60%** of its **annual rainfall** during this period, making it the most crucial rainfall season for the state. **Andhra Pradesh, Karnataka,** and **Kerala** also benefit from these rains.
  - The monsoon is driven by weather systems such as **low-pressure areas, depressions, and cyclonic circulations** that form in the **Bay of Bengal.**
- **Weather Systems**:
  - The formation of **low-pressure systems** in the **Bay of Bengal** is critical for triggering **heavy rainfall** along the **eastern and southeastern coast.**
  - These systems often move **westward,** bringing rainfall to **Tamil Nadu** and **Andhra Pradesh,** and sometimes affecting **Kerala** and **southern Karnataka.**
- **Influence of Global Phenomena**:
  - **El Niño-Southern Oscillation (ENSO)** and **Indian Ocean Dipole (IOD)** can influence the **intensity** and **variability** of the **Northeast monsoon.**
  - **Positive IOD phases** typically bring **more rainfall,** while **El Niño** conditions may lead to **reduced rainfall.**
- **Impact on Agriculture**:
  - The **Northeast monsoon** is vital for **winter cropping** in the southern states. Crops like **rice, groundnuts, pulses,** and **millets** depend heavily on this monsoon.
  - The timing and amount of rainfall can significantly impact crop yields and water availability in these regions.
- **Urban Flooding**:
  - Cities like **Chennai** and coastal areas of **Tamil Nadu** and **Andhra Pradesh** are often prone to **urban flooding** during this season due to heavy rains, compounded by poor drainage systems.

Importance of the Northeast Monsoon:

- The **Northeast monsoon** accounts for nearly 30% of the total annual rainfall for the **Peninsular region**.
- **Tamil Nadu** relies heavily on this monsoon for replenishing water reservoirs, which is critical for drinking water supply, agriculture, and hydropower.

Flooding hits Sahara Desert after extremely rare rainfall
Sub :Geo
SEC: Climatology
Context:

- **Rare rainfall** recently hit some of the **driest regions on Earth,** including parts of the **Sahara Desert,** leaving behind an unexpected **abundance of water in arid areas**.

Key Details:

- In **south eastern Morocco**, the desert, which rarely experiences rain in late summer, saw **heavy downpours** in September.
- In **Tagounite**, located **450 km** (280 miles) south of **Rabat**, over **100 mm (3.9 inches)** of rain fell in just 24 hours.
- The rainfall created striking scenes with **blue lagoons** appearing amidst palm trees and sand dunes, nourishing regions that have been drought-stricken for decades.
- Satellites detected water filling **Lake Iriqui**, a lakebed that had been dry for 50 years, located between **Zagora and Tata**.
- **Meteorological Insights**:
  - The heavy downpour has been described as an **extratropical storm**.

- o The influx of moisture into the atmosphere could lead to **more frequent storms** in the future, potentially altering the **region's weather patterns.**
- **Drought Challenges**:
  - o **Morocco** has faced **six consecutive years of drought**, affecting farming and forcing water rationing in cities and villages.
  - o The rainfall is expected to help **refill groundwater aquifers** and replenish dammed reservoirs at record rates.
- **Negative Consequences**:
  - o Despite the benefits, the storms caused **over 20 deaths** in **Morocco** and **Algeria.**
  - o Flooding damaged **farmers' crops,** and the government had to allocate **emergency relief funds**, particularly in areas also affected by last year's earthquake.

Morocco:

- **Morocco** is a country in **North Africa.**
- **Geography:**
  - o Located in the **Maghreb region** of **North Africa**
  - o **Borders:** Algeria, Western Sahara, Mediterranean Sea, and Atlantic Ocean
  - o Capital: **Rabat**
  - o Largest city: **Casablanca**
  - o Official languages: **Arabic** and **Berber (Amazigh)**
- **Economy:**
  - o Mixed economy with growing industrial and tourism sectors
  - o **Key industries:** agriculture, phosphate mining, textiles, automotive
  - o **Emerging sectors:** aerospace, renewable energy
- **Notable Features:**
  - o Contains part of the **Atlas Mountains**
  - o Home to the **Sahara Desert** in the south

Impact of Atlantic Ocean Hurricane Forecasts on India: Climate Stressors and Cyclone Predictions

Sub : Geo

Sec :Climatology

Why in News

Countries surrounding the Indian Ocean are increasingly vulnerable to climate change, both in terms of **chronic stressors** like warming oceans and **acute stressors** such as cyclones and extreme weather events. The **Atlantic hurricane** forecasts have prompted a fresh look at the state of **India's own weather prediction capabilities** and the potential effects on regional climate dynamics.

Global Climate Stressors Impacting Indian Ocean Region

Chronic Stressors: These include **rising sea levels, warming oceans, and increased extreme rainfall events.** Chronic stressors **occur consistently over time,** making the region more susceptible to acute stressors.

Acute Stressors: These are events that **exacerbate the impact of chronic conditions,** such as cyclones, heavy rainfall, and flash droughts. **Acute stressors often cause sudden, severe damage.**

Hurricane and Cyclone Forecasts:

Meteorologists had predicted a historic hurricane season for 2024 based on the expected development of La Niña. However, despite early hurricanes like **Helene and Milton,** the strong La Niña conditions have not materialized as forecasted.

El Niño and La Niña Effects: Historically, **El Niño tends to suppress cyclones, while La Niña intensifies them.** However, the global warming patterns observed during 2023-2024 have altered this predictable link.

What is Hurricane:

A hurricane is a powerful and destructive **tropical storm** characterized by strong winds, heavy rainfall, and low **atmospheric pressure.**

Hurricanes are also known as **cyclones or typhoons** in different parts of the world.

In the **Atlantic Ocean and Northeast Pacific**, they are called hurricanes, while in the north western Pacific, they are referred to as typhoons, and in the South Pacific and Indian Ocean, they are known as cyclones.

About EL Nino

El Nino refers to the **large-scale ocean-atmosphere climate interaction** linked to periodic **warming in sea surface temperatures** across the **central and east-central Equatorial Pacific.**

It is **associated with high pressure in the western Pacific**. El Nino adversely impacts the Indian monsoons and hence, agriculture in India.

El Nino means **lesser than average rains for India.** Indian agriculture is heavily dependent on the monsoons and because of this, lesser rainfall during the monsoons generally translates to below-average crop yields.

What happens because of El Nino?

The **cool surface water off the Peruvian coast goes warm because of El Nino**. When the water is warm, the **normal trade winds get lost or reverse their direction**.

Hence, the **flow of moisture-laden winds is directed towards the coast of Peru** from the **western Pacific** (the region near northern Australia and South East Asia).

This causes **heavy rains in Peru** during the El Nino years robbing **the Indian subcontinent of its normal monsoon rains**. The larger the temperature and pressure difference, the larger the rainfall shortage in India.

About La Nina:

It means the **large-scale cooling of ocean surface temperatures in** the **central and eastern equatorial Pacific Ocean**, together with changes in the tropical atmospheric circulation, namely winds, pressure and rainfall.

It has the **opposite impacts on weather and climate as El Niño,** which is the warm phase of the El Niño Southern Oscillation (ENSO).

Weather Changes due to La Nina:

The **Horn of Africa and central Asia** will see **below average rainfall due to La Niña.**

East Africa is forecast to see drier-than-usual conditions, which together with the existing impacts of the desert locust invasion, may add to regional food insecurity.

It could also lead to **increased rainfall in southern Africa**.

It could also affect the **South West Indian Ocean Tropical Cyclone season**, reducing the intensity.

Southeast Asia, some Pacific Islands and the northern region of South America are expected to receive above-average rainfall.

In **India, La Niña means the country will receive more rainfall than normal,** leading to floods.

Cyclone Activity in the North Indian Ocean

The **North Indian Ocean, particularly the Arabian Sea,** has witnessed an **increasing number of cyclones.** While the region has been relatively quiet in recent years, **this unpredictability only highlights the difficulty in forecasting future cyclone patterns.**

Rapid Intensification: Cyclones gain energy from the upper ocean layers, and as these waters warm, cyclones may intensify rapidly, with wind speeds increasing by over **55 km/h in less than 24 hours.**

India's Progress in Cyclone Forecasting and Disaster Management

Improved Forecasting Systems: India has made significant strides in improving its cyclone forecasting capabilities, with advanced early warning systems that have helped reduce loss of lives.

Geographical Advantages: The areas over the Arabian Sea and Bay of Bengal where cyclones typically intensify are relatively small, limiting their size and strength. Additionally, many cyclones are steered away from India's mainland, reducing their potential impact.

About Tropical Cyclone:

A tropical cyclone is **an intense circular storm that originates over warm tropical oceans** and is characterized by low atmospheric pressure, high winds, and heavy rain.

A **characteristic feature** of tropical cyclones is the **eye,** a central region of clear skies, warm temperatures, and low atmospheric pressure.

Storms of this type **are called hurricanes** in the **North Atlantic and eastern Pacific** and **typhoons in South-East Asia and China.** They are called **tropical cyclones in the southwest Pacific and Indian Ocean** region and **Willy-willies** in north-western

Storms **rotate counter-clockwise** in the **northern hemisphere** and **clockwise in the southern**

The **conditions favourable** for the **formation and intensification** of tropical storms are:

- **Large sea surface** with **temperature higher than 27° C.**
- Presence of the **Coriolis force.**
- Small variations in the **vertical wind speed.**
- A pre-existing weak low-**pressure area or low-level-cyclonic circulation.**
- **Upper divergence** above the sea level system.

Spraying diamond dust to cool Earth: What a new study proposes, despite 'geoengineering' concerns
Sub: Geo
Sec: Climatology

Context:
- A recent study suggests **spraying millions of tonnes of diamond dust** in the **Earth's upper atmosphere annually** to cool the planet and combat global warming.
- **Other compounds**—sulphur, calcium, aluminium, and silicon—have also been proposed to reflect solar radiation and reduce Earth's temperature.
- **Alternative proposal:** Installing space-based mirrors to reflect sunlight.

What is Geoengineering?
- It refers to **large-scale efforts to alter Earth's climate** to mitigate global warming.
- **Two main types:**
  - **Solar Radiation Management (SRM):** Reflects sunlight away from Earth.
  - **Carbon Dioxide Removal (CDR):** Removes CO_2 from the atmosphere.

Current Geoengineering Efforts:
- **Solar Radiation Management (SRM):** Inspired by **volcanic eruptions** (e.g., 1991 Mount Pinatubo) that release **sulphur dioxide,** forming particles that reflect sunlight.
  - The study found **diamond dust** could be more effective than other materials in SRM.
  - To lower temperatures by **1.6°C,** approximately **5 million tonnes of diamonds** would need to be dispersed annually.
- **Carbon Capture and Storage (CCS):** Captures **CO_2** at the source and stores it underground, currently the most-used method.
- **Carbon Capture, Utilisation, and Storage (CCUS):** Uses some captured **CO_2** in industries and stores the rest.
- **Direct Air Capture (DAC): "Artificial trees"** extract CO_2 from ambient air, then store or utilize it.
- **Ocean fertilization or ocean nourishment:**
  - Ocean fertilization is a type of climate engineering based on the purposeful introduction of nutrients to the upper ocean to increase marine food production and to remove carbon dioxide from the atmosphere.
  - A number of techniques, including fertilization by iron, urea and phosphorus have been proposed.
- **Soil carbon sequestration (SCS)**
  - Soils can serve as a sink for carbon dioxide since atmospheric concentrations of carbon dioxide have crossed 410 parts per million and oceans are already turning acidic.
  - **Carbon sequestration** in soils has the potential to offset GHG emissions from fossil fuels by up to 15% annually.
  - Soil organic carbon (SOC) comes from plants, animals, microbes, leaves and wood, mostly found in the first metre or so.
  - There are many conditions and processes that determine changes to SOC content including temperature, rainfall, vegetation, soil management and land-use change.
- **Stratospheric aerosol injection (SAI)**
  - **SAI** is the main type of solar radiation management (SRM) .
  - In the case of SAI, gases are pumped into the stratosphere to reflect some of the sun's heat, mimicking an effect that happens naturally in a strong volcanic eruption.
  - Scale of **SAI** makes its governance difficult — implementing it in one country can trigger rain and extreme weather across borders. Lack of public support might be the biggest hurdle.
- **Marine cloud brightening (MCB)**
  - MCB involves reflecting sunlight away from the earth in some way. In this case, sea salt or other particles are sprayed into marine clouds to make them thicker and more reflective.
- **Cirrus cloud thinning (CCT)**
  - CCT is almost the opposite of marine cloud brightening. High-altitude Cirrus clouds are thin and whispy, so they don't reflect much solar radiation back into space, and instead trap long-wave radiation on earth.
  - CCT proposes thinning them further through cloud seeding, letting more long-wave radiation escape.

Challenges and Concerns:
- **Technical and Financial Challenges:**
  - **SRM** has high technological and financial demands.
  - Using **CCS** extensively could cost around **US$ 30 trillion more by 2050** than prioritizing renewables and energy efficiency.

- **Potential Risks:**
  - SRM could unintentionally disrupt weather patterns, affect rainfall, and impact agriculture and biodiversity.
  - Heavy reliance on CCS alone may be unsustainable without an adequate number of safe underground storage sites.

Urgency and Emission Goals:

- **Rising Global Temperatures:** Despite efforts, temperatures are **1.2°C above** pre-industrial levels, with **2023** around **1.45°C warmer.**
- **Paris Agreement Target:** Aims to limit warming below **1.5°C** but achieving this requires a **43% cut in emissions by 2030,** while current actions may **only achieve a 2% reduction.**
- **Role of CCS/CDR:** These technologies are now viewed as essential to any scenario aiming to meet the **1.5°C or 2°C targets.**

What is DANA, the weather pattern which caused flash floods in Spain?

Sub : Geo

Sec: Climatology

Torrential Rain in Spain:

- Since Monday night (October 28), **heavy rains** in **southern** and **eastern Spain** have caused **severe flooding**, affecting millions, submerging towns, and cutting off roads.
- **Flash floods** have led to at least 64 deaths in Valencia, eastern Spain.

Rainfall Intensity:

- Some areas received over a month's worth of rain in a single day.
- Andalusia, the southernmost region, recorded four times the typical October rainfall.
- **Spain's meteorological agency** noted rainfall between 150-200 liters per square meter (about 40-50 gallons per square yard) within two hours.

Weather Phenomenon - DANA (Cold Drop):

- **What is DANA?**
  - Known as **"gota fría"** or **"cold drop,"** DANA is an annual phenomenon caused by **cold air descending over the warm Mediterranean Sea**, leading to atmospheric instability.
  - This instability causes **warm, moist air over the sea to rise quickly,** forming dense cumulonimbus clouds that release heavy rainfall.
- **How it Forms?**
  - Related to the **polar jet stream,** which **separates cold polar air from warm tropical air.**
  - When a pocket of **cold air** detaches from this **jet stream** and meets **warmer air** over the **Mediterranean, DANA** forms, often bringing intense rain.

Increasing Intensity of DANA:

- Traditionally, **cold drops** are common in **Spain** during **autumn** and **spring**.
- DANA events are now more **frequent, intense,** and **geographically widespread**.
- **Rising global temperatures** mean **warmer air** retains more moisture, contributing to intense rainfall.
- **Increased Mediterranean Sea surface temperatures** exacerbate this; in August, the sea reached its highest recorded temperature.

Carbon-Trapping Sedimentary Rock from Slag: A New Hope for Carbon Sequestration

Sub : Geo

Sec: Geomorphology

Why in News

Recent studies have highlighted the formation of **a new type of sedimentary rock from coastal slag deposits,** which is capable of **capturing carbon dioxide** through a process called **mineral carbonation.** This discovery is crucial as it opens up new possibilities for mitigating industrial carbon emissions.

About Coastal Slag:

Slag is a **by-product of the steelmaking process,** primarily consisting of **metal oxides and silicon dioxide.**

Generated by **industrial activities,** especially in **iron and steel industries,** and deposited in coastal regions.

Contains various minerals like **calcium silicate (larnite), metal oxides, and calcite,** making it chemically stable.

Can **neutralize soil acidity** but **may release toxic metals** (e.g., chromium, vanadium) into the environment when weathered.

New Type of Sedimentary Rock from Coastal Slag: Created through the process of **lithification**, where slag hardens over time, turning into sedimentary rock.

Carbon Sequestration: The rock captures carbon dioxide through **mineral carbonation**, where CO_2 reacts with calcium in the slag to form **calcite** ($CaCO_3$).

Dual Lithification Mechanisms:

Calcite Cement Precipitation: Occurs on the surface of slag deposits, capturing CO_2 from the atmosphere.

Calcium-Silicate-Hydrate (CSH) Precipitation: Takes place in intertidal zones, forming CSH minerals in seawater-exposed areas.

Applications of Slag Lithification

Carbon Sequestration Potential: The **calcite cement mechanism** effectively **captures CO_2** from the atmosphere without additional processing, offering a sustainable solution for carbon sequestration. The lithification of slag stores greenhouse gases like CO_2. **Projections indicate a 10.5% rise in global slag production by 2031,** emphasizing the **need for carbon capture strategies** in the steel industry.

Environmental Benefits: The formation of CSH minerals could **reduce the release of harmful metals** like vanadium and chromium into the environment.

Resource Recovery: Understanding **slag lithification may help recover valuable materials** and increase recycling in steelmaking.

Coastal Protection: Hardened slag could be **repurposed for coastal erosion prevention** by serving as a barrier against waves and tides.

What is Mineral Carbonation:

Mineral carbonation is a **natural process in which carbon dioxide (CO_2) reacts with minerals, particularly those containing calcium, magnesium, or iron, to form stable carbonate minerals** like calcite ($CaCO_3$), magnesite ($MgCO_3$), or siderite ($FeCO_3$).

Natural Process: Occurs over **long geological timescales,** contributing to the Earth's carbon cycle by removing CO_2 from the atmosphere.

Artificial Mineral Carbonation: Scientists are **replicating this process to sequester carbon as a method of combating climate change,** often using industrial by-products like slag.

Carbon-13 Isotope Analysis: aids in the understanding of carbon dynamics during carbonation.

About Carbon sequestration:

Carbon sequestration refers to the **process of capturing and storing carbon dioxide** (CO2) from the atmosphere and preventing it from being released back into the atmosphere. It **plays a crucial role in mitigating climate change** by reducing greenhouse gas emissions and stabilizing the carbon cycle.

Carbon sequestration is the **long-term storage of carbon** in various reservoirs, such as forests, soil, oceans, and geological formations, to remove CO2 from the atmosphere.

Natural ecosystems, such as **forests, wetlands, and oceans**, act as important carbon sinks by absorbing and storing carbon through processes like photosynthesis and biological activity. Preserving and restoring these ecosystems is crucial for enhancing carbon sequestration.

Planting new forests (afforestation) or restoring degraded forests (reforestation) can significantly increase carbon sequestration. Trees absorb CO2 through photosynthesis, storing carbon in their biomass and in the soil.

Blue carbon refers to the **carbon stored in coastal and marine ecosystems**, such as mangroves, seagrasses, and salt marshes. Protecting and restoring these habitats is important for preserving their carbon sequestration capacity.

Carbon capture and storage technologies involve capturing CO2 emissions from power plants, industrial facilities, and other sources, and then storing it in underground geological formations, such as depleted oil and gas reservoirs or saline aquifers.

Direct air capture is a technology that directly removes CO2 from the atmosphere using specialized machines. The captured CO2 can be stored underground or used for various purposes, such as enhanced oil recovery or the production of synthetic fuels.

Aurorae Sightings in Ladakh Validate Space Weather Tracking Efforts

Sub : Geo

Sec : Geomorphology

Why in News

The recent sightings of **aurorae in Ladakh,** typically observed in far northern regions, have validated India's space weather tracking efforts. A team of Indian astrophysicists predicted the event 48-72 hours in advance, showcasing progress in forecasting space weather, which can have significant effects on satellite-based services.

About Auroras:

Auroras are **natural light** displays that occur when **charged particles from solar winds interact with the Earth's magnetosphere**.

- The **magnetosphere** is the **region surrounding the Earth** where the dominant magnetic field is the **Earth's**, rather than the magnetic field of interplanetary Space.
- It **protects** the Earth against **solar winds** and is **strongest at the poles**.

These particles travel along the **Earth's magnetic field** and upon colliding with atmospheric molecules and atoms, cause **emissions of light** seen as auroras.

In North Pole- **Aurora Borealis**

In South Pole- **Aurora Australis**

What Causes Aurorae in Ladakh?

The aurorae in Ladakh were triggered by **solar storms**, particularly **coronal mass ejections (CMEs)**. These CMEs are massive bursts of solar wind and magnetic fields rising above the Sun's corona, released into space.

Solar activity intensifies and weakens in an **11-year solar cycle**, driven by the **Sun's internal magnetic field.** The current solar activity cycle was predicted to peak in 2024, leading to more frequent and intense space weather phenomena.

Coronal Mass Ejections (CMEs) are **large expulsions of plasma and magnetic fields** from the **Sun's corona**.

Impact of Solar Storms:

The **CMEs,** travelling at **high speeds (700- 815km/second)**, significantly **disturbed the Earth's magnetic field**, affecting the **space weather.**

This activity was part of a **series of solar flares and storms** predicted to continue affecting the Earth around this period.

The **intense solar storms** pose **risks to satellites in Low Earth Orbit (LEO) (an altitude ranging between 200-1,600km)**, affecting their operations due to induced **heating** in the **upper atmosphere** and **potential drag effects**.

This can result in **radiation hazards** and **physical damage** to **satellites**, potentially **compromising navigation, communication, military, and intelligence systems** relying on these satellites.

Importance of the Observation

The sightings were captured by all-sky cameras operated by the **Indian Institute of Astrophysics (IIA)** at **Hanle and Merak in Ladakh.**

These observations highlight the success of space weather monitoring efforts in India and are a significant validation of the accuracy of predictions made by Indian astrophysicists.

About Indian Astronomical Observatory (IAO): IAO is a **high-altitude astronomy station** operated by the **Indian Institute of Astrophysics**.

IAO stands on **Mt. Saraswati, Digpa-ratsa Ri, Hanle** in the **south-eastern Ladakh** Union territory of **India.**

- **Nyoma, 75 km northwest** of **Hanle,** has an **Indian military airbase**.

Situated in the **Western Himalayas** at an **elevation of 4,500 meters** (14,764 ft), the IAO is **one of the world's highest-located sites for optical, infrared and gamma-ray telescopes.**

It is currently the **tenth-highest optical telescope** in the **world.**

- It is **India's first dark-sky reserve**.
- **Changthang Wildlife Sanctuary** in **Changthang plateau** is also located here.

The **Observatory** has **several active telescopes.** These are the 2.01 meter optical-infrared **Himalayan Chandra Telescope (HCT)**, GROWTH-India telescope, **Cassegrain telescope,** and a **High-Altitude Gamma Ray Telescope (HAGAR)**.

The **HCT** is **remotely operated** from **Bangalore** from the **Centre for Research and Education in Science and Technology (CREST)** using a dedicated satellite link.

Demand for ST Status for Tea Tribes

Sub :Geo

Sec: Human geo

Why in News

Jharkhand Chief Minister has raised the long-pending demand for **Scheduled Tribe (ST) status for Assam's "tea tribes."**

Tea Tribes of Assam:

The tea garden workers, now known as the **"tea tribes" or "ex-tea garden tribes,"** were originally **brought to Assam by British colonialists during the mid-19th century.** These workers were primarily from regions such as **Odisha, Jharkhand, Madhya Pradesh, Bihar, Andhra Pradesh, and West Bengal,** and they were employed as indentured labourers in Assam's tea plantations. Over time, many of them permanently settled in Assam, forming a distinct community.

The tea tribes are **officially recognized as Other Backward Classes (OBC) by the Government of India.** Despite their significant contributions to Assam's economy—particularly in the tea industry, where **they contribute to over 53% of India's total tea production**—the community faces considerable socio-economic challenges.

Demand for ST Status: Due to their socio-economic disadvantages and historical roots, the **tea tribes have been demanding Scheduled Tribe (ST) status in Assam.** Gaining this status would provide them with **additional political, economic, and social benefits, including reservations in education, employment, and political representation.**

Some of the prominent tea tribes in Assam include:**Santhal**, **Munda**, **Oraon**, **KurukhGond** and **Kharia.**

Constitutional Provisions for ST Status

Article 341 (1): Empowers the President to specify which castes, races, or tribes in each state or union territory shall be classified as Scheduled Castes (SCs).

Article 341 (2): Any subsequent inclusion or exclusion from the SC list can be done by Parliament through a law.

Article 342 (1): The President, after consultation with the Governor of the respective state, specifies tribes or tribal communities to be classified as Scheduled Tribes (STs).

Criteria for ST Classification: Tribes are identified based on factors such as geographical isolation, distinctive culture, backwardness, and socio-economic deprivation.

The tea tribes of Assam, descendants of labourers brought during the British era, are classified as **OBCs** and have been demanding **ST status** for years.

The **Scheduled Tribes Amendment Bill (2019)** was introduced in the Rajya Sabha to grant ST status, but it has yet to be passed.

Assam Tea Gardens:

Assam tea is renowned for its robust, **malty flavor and deep color.** It is one of the finest black teas globally and is widely consumed both as single-estate tea and in blends like English Breakfast Tea.

Location: Assam is situated along the **Brahmaputra River, with tea gardens mostly on its fertile plains.**

Climate: The region's **tropical climate, characterized by heavy rainfall and humidity,** creates ideal conditions for tea cultivation

Historical Background: The British established tea production in **Assam in the 19th century, making it the first large-scale tea cultivation area outside of China.**

Production: Assam is one of the largest tea-producing regions in the world, contributing significantly to **India's tea exports.**

Special Time Zone: Assam's tea gardens operate in a separate time zone, **"Tea Garden Time" (an hour ahead of Indian Standard Time), to optimize daylight usage.**

About Tea:

Tea is a **tropical and sub-tropical plant** and grows well in **moderately hot and humid climates.**

The ideal temperature for its **growth is 20°-30°C and temperatures above 35°C and below 10°C are harmful for the bush.**

It requires **150-300 cm annual rainfall** which should be well distributed throughout the year.

The most suitable soil for tea cultivation is slightly **acidic soil (without calcium)** with **porous sub-soil** which permits a free percolation of water.

The major tea-producing states in India are: **Assam, West Bengal, Tamil Nadu, Kerala, Tripura**, Arunachal Pradesh, Himachal Pradesh, Karnataka, Sikkim, Nagaland, Uttarakhand, Manipur, Mizoram, Meghalaya, Bihar, Orissa.

Shompen Tribe of Nicobar

Sub: Geo

Sec: Human geo

Why in News

The **Shompen tribe of the Nicobar Islands** has recently come into the spotlight due to concerns over a major infrastructure project on **Great Nicobar Island,** which threatens their forest home. The project includes plans for a **transshipment container terminal, port, and solar power plant,** raising environmental and anthropological concerns.

About Shompen Tribe:

- The **Shompen tribe is a semi-nomadic, forest-dwelling community that has inhabited the Great Nicobar Island for over 60,000 years.** Unlike the coastal Nicobarese tribe, the Shompen live in the island's interior, relying heavily on the forest for their sustenance and survival.

- The **Shompen** are **one of the most isolated tribes** on **Earth**. They reside in the **dense tropical rainforest** of the **Great Nicobar Island** of **Andaman and Nicobar group of Islands.**

- They are **one of the least studied Particularly Vulnerable Tribal Groups (PVTGs)**in India.

- Though according to the **Census (2011),** the estimated **population of Shompen** is **229,** the exact population of Shompen is unknown till today.

- Most of them are **uncontacted, refusing all interactions with outsiders.**
- They live in **small groups**, whose territories are identified by the **rivers** that **criss-cross the rainforest.**
- They are **semi-nomadic hunter-gatherers,** and their **main sources of livelihood** are hunting, gathering, fishing, and **a little bit of horticultural activities** in a rudimentary form.
- Primarily, they used to **hunt wild pig, python, monitor Lizard, crocodile, see turtle etc.**
- They collect a wide variety of **forest plants,** but their **staple food** is the **pandanus fruit,** which they call
- **Shompen** speak their own language, which has many Members of one band do not understand the dialect of the other.
- They are of **short to medium stature,** have a **round or nearly broad head shape, narrow nose, a broad facial profile,** and **distinctly exhibit Mongoloid features** such as **light brown to yellow-brown skin** and **oblique eye features.**
- **Shompen** have **nuclear families** comprising **husband, wife,** and their **unmarried children.**
- A **Shompen family** is controlled by the **eldest male member,** who controls all activities of the **women and kids. Monogamy** is the **general rule,** although **polygamy** is allowed too.

About Great Nicobar:
- **Great Nicobar** is the **southernmost tip of India,** part of the **Andaman and Nicobar archipelago** with over **600 islands**.
- It is hilly, covered with lush rainforests, and receives about **3,500 mm of annual rainfall.**
- The **island** hosts **endangered** and **endemic species** like the **giant leatherback turtle, Nicobar megapode, Great Nicobar crake, Nicobar crab-eating macaque,** and **Nicobar tree shrew.**
- It has an area of 910 sq km with **mangroves** and **Pandan forests** along its coast.

About the Great Nicobar Development Project:

A **"greenfield city"** has been proposed, including

- An **International Container Transshipment Terminal (ICTT),**
- A **Greenfield International Airport,**
- A **power plant,** and
- A **township for the personnel** who will implement the project.

A total of 166.1 sq km along the island's southeastern and southern coasts have been identified for the project along a coastal strip of width between 2 km and 4 km.

Some 130 sq km of forests have been sanctioned for diversion, and 9.64 lakh trees are likely to be felled.

The port will be **controlled by the Indian Navy,** while the airport will have **dual military-civilian functions** and will **cater to tourism** as well.

Roads, public transport, water supply and waste management facilities, and several hotels have been planned to cater to tourists**.**

Use of Salt Pan Land for Housing: Ecological and Urban Planning Concerns in Mumbai

Sub: Geo

Sec: Eco geo

Why in News

The Maharashtra government has recently allocated 255.9 acres of **salt pan land in Mumbai's eastern suburbs** for the construction of rental housing as part of the **Dharavi Redevelopment Project.** This decision has sparked controversy among urban planners and environmentalists, who emphasize the ecological importance of salt pans as natural flood defences and the potential environmental impact of their use for intensive development activities.

What are Salt Pan Lands?

Salt pans are **low-lying lands** where seawater flows during certain times and evaporates, leaving behind **salt and minerals**.

Ecosystem Role: Salt pans, alongside **mangroves,** play a crucial role in protecting **Mumbai from flooding**.

National Distribution: Across India, **60,000 acres** of land are classified as salt pans, spread across **Maharashtra, Andhra Pradesh, Tamil Nadu, Odisha, Gujarat, and Karnataka**. Andhra Pradesh holds the largest share with **20,716 acres**, followed by **Tamil Nadu (17,095 acres)** and **Maharashtra (12,662 acres)**.

Regulation: As per the **Coastal Regulation Zone (CRZ) notification of 2011**, these ecologically sensitive areas fall under the **CRZ-1B category**, where economic activities are restricted, except for **salt extraction** and **natural gas exploration**.

Distribution of Salt Pan Lands in Mumbai: Mumbai has **5,378 acres** designated as salt pan lands, which is **nine times the size of the Dharavi slum**.

Why Are Mumbai's Salt Pans at Risk?

High Land Demand: Mumbai's limited land drives development into salt pans.

Housing Projects: Salt pans are being used for affordable housing under the **Dharavi Redevelopment Project.**

Regulatory Evasion: Attempts are being made to bypass **Coastal Regulation Zone restrictions**.

Flood Risk: Salt pans help prevent flooding; their destruction increases flood risks.

Ecosystem Threat: Salt pans support biodiversity and flood control, making their loss impactful.

Policy Contradiction: Development projects conflict with climate action plans aimed at flood prevention.

The **Maharashtra government** has allocated **255.9 acres** of salt pan land for housing under the **Dharavi Redevelopment Project.**

These land parcels are divided into three major tracts:

- **120.5 acres at Arthur Salt Works, Kanjur**
- **76.9 acres at Jenkins Salt Works, Kanjur and Bhandup**
- **58.5 acres at Jamasp Salt Works, Mulund**

What is Dharavi Redevelopment Project:

The state had **envisaged** this sprawl be transformed into a **cluster of high-rises** with **improved urban infrastructure.** It entailed **resettling 68,000 people**, including slum dwellers and those with commercial establishments.

The **state was to provide 300-sqft houses for free** to residents with proof that their **slum structure was in existence before January 1, 2000**. The project was **initially mooted in 2004**, but never got off the ground due to various reasons.

More about Dharavi:

Dharavi is famous as **one of the world's largest slums and is located** in the heart of India's financial capital Mumbai.

The Dharavi slum came into **being in 1884**.

It was originally **inhabited by fisherfolk** when the area was still creeks and swamps.

It became **attractive to migrant workers from South Mumbai** and others when the swamp began to fill in due to natural and artificial causes.

Gold: what makes it so desirable?

Sub: Geo

SEC: Eco geo

Context:

- Each of the Nobel Prizes to be awarded from October 7 will include a medal of **electrum, an alloy of gold and silver**, plated with 24 carat gold.

About Gold:

- Atomic Number: 79
- Latin Name: Aurum (Symbol: Au)
- Gold nuggets are typically found in mountainous areas with quartz veins.

Desirability:

- Gold is a precious metal famed for its use in jewellery and as a form of investment.
- Approximately 10% of global gold production is used in industry, mostly used for **connectors in computers.**
- Gold is a significant part of national reserves and is often held by central banks.

Characteristics:

- Doesn't dissolve in strong nitric acid.
- Malleable, ductile, corrosion-resistant.
- Good conductor of electricity.
- Dissolves in aqua regia (a mix of nitric and hydrochloric acids).
- Dissolves in some alkaline solutions and mercury.
- **Noble Metal**: Among noble metals **gold is less reactive than all except platinum**.

Global Production:

- South Africa was the leading producer since the late 19th century.
- Currently, **China is the largest producer**.Major producers include Australia, Russia, the USA, and Canada.

Indian Context:

- India is one of the largest consumers of gold, primarily for jewellery.
- Karnataka is the largest producer of gold in India.

Telangana's dry port logistics drive

Sub: Geo

Sec: Eco geo

Context:

- **Dry Port** Development in **Telangana**.

What is a Dry Port?

- A **dry port** is an **inland terminal** that connects to a seaport by rail or road, acting as a trans-shipping hub for **sea cargo**.
- Exporters can complete **all customs formalities** at the **dry port,** saving time and reducing costs.
- In addition to their role in cargo transhipment, **dry ports** may also include facilities for **storage and consolidation of goods, maintenance for road or rail cargo carriers** and **customs clearance services.**
- The location of these facilities at a **dry port** relieves competition for storage and customs space at the seaport itself.
- **In India, dry ports are in:** Andhra Pradesh, Assam, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, West Bengal.

Telangana Government's Initiative:

- The Telangana government is working on developing a **dry port** in the **northern corridor** of the state, in a **public-private partnership (PPP) mode**.
- The State **aims** to enhance its **logistics infrastructure** to support industrial development and boost exports.
- **Feasibility studies** are ongoing to consider setting up additional dry ports to further increase export capabilities.
- At present, exports from Telangana are routed through ports in **Tamil Nadu** and **Andhra Pradesh**, increasing logistical complexities.

Previous Proposals:

- In July 2021, the government, under K Chandrasekhar Rao's leadership (then known as Telangana Rashtra Samithi, now Bharata Rastra Samithi), approved plans for a **1,400-acre multi-modal logistics park** near **Nalgonda** through a **PPP model.**
- It also decided to establish **two integrated container depots (ICDs)** in **Hyderabad,** similar to the **Concor ICD** at **Sanathnagar,** to collaborate with the **Customs department and promote exports.**
- A proposal to set up **10 additional integrated logistics parks** across **Telangana** was also approved, but none of these projects, including the **dry port,** have commenced.

Importance of Logistics for Telangana:

- **Telangana**'s industrial strengths include **pharmaceuticals, food processing, textiles,** and the **defence** and **aerospace sectors.**
- A **robust logistics infrastructure** is crucial to support these industries and enhance export capabilities.
- According to government data, Telangana's **logistics sector is growing at 12% annually**, and the development of **industrial corridors** will likely increase demand for logistics services further.

Mineral Reserves Crucial for the Global Energy Transition

Sub: Geo

Sec: Eco geo

Why in News

The global shift from **fossil fuels to renewable energy sources is accelerating** the demand for specific minerals essential for technologies like **solar, wind, nuclear power, and electric vehicles.** As nations strive to meet their climate goals, understanding the distribution of these **critical mineral reserves** is essential for achieving a sustainable and low-carbon future. **The latest 2024 data highlights which countries hold the largest reserves of these vital minerals, crucial for driving the clean energy transition.**

Mineral	Key Details

Bauxite	**Primary source of aluminum,** crucial for renewable energy technologies (wind turbines, solar panels). Important for **low-carbon energy transition. Guinea has by far the world's largest reserves of bauxite**
Chromium	Used in **geothermal energy systems,** concentrated solar power, and wind turbines. Important for **high-temperature applications and corrosion-resistant materials.**
Cobalt	Vital for **lithium-ion batteries** in electric vehicles, consumer electronics. **Cobalt-60 isotope used in medical treatment.** Demand is rising due to **electric vehicle production.**
Copper	Essential for **solar photovoltaics,** wind power, and electric grids. Critical for **wiring in renewable energy systems** and electric vehicles due to excellent conductivity.
Graphite	Key for **battery anodes in electric vehicles** and energy storage systems. Significant for **consumer electronics and large-scale renewable energy solutions,** especially in balancing electricity grids.
Lithium	Core element in **lithium-ion batteries for electric vehicles and energy storage.** Demand rising due to electric vehicles and focus on **sustainable extraction methods.**
Manganese	Used in **solar and wind power systems,** lithium-ion batteries, and electric vehicles. Also essential for **steelmaking,** critical for clean energy infrastructure.
Molybdenum	**Highly conductive and stable at high temperatures,** used in turbines and nuclear reactors. Valuable for industrial applications and energy technologies **due to expansion properties under heat.**
Nickel	Crucial for **cathodes in lithium-ion batteries,** especially for electric vehicles. Focus on reducing dependence on fossil fuels through electric vehicle industry growth.
Rare Earths	Used in **permanent magnets** for wind turbines and electric vehicle motors. Vital for renewable energy sector in efficient power generation systems.
Silver	Significant role in **solar photovoltaics,** critical for solar energy and electric vehicles. Important for medical applications and electronics, with solar energy as a dominant sector.
Uranium	Primary fuel for **nuclear energy production,** essential for clean energy generation. Crucial for stable, low-carbon energy through nuclear reactors, important in the energy transition.

Why is the textile industry struggling to perform better?
Sub: Geo
Sec: Eco geo

Context:

- The **Indian textile and apparel sector** aims for a **$350 billion business by 2030**, expected to generate **3.5 crore jobs**.
- The industry faced a **tumultuous phase** over the last two financial years, casting doubt on achieving a **10% CAGR**.

Size and Global Standing (2021):

- Estimated size: **$153 billion** (with **$110 billion** from domestic business).
- India was the **third-largest textile exporter globally in FY22**, holding a **5.4% share**.
- **Second largest** in terms of **manufacturing capacity**, with a comprehensive value chain.
- The sector contributes about **2.3% to GDP** (FY21) and **10.6% of manufacturing GVA** (FY23).
- Employs **105 million people** directly and indirectly.

Recent Slowdown (2022-2024):

- **Impact on Manufacturing**:
  - Slowing demand starting from **FY23** worsened in **FY24**, with significant drops in both **exports and domestic demand**.
  - **Tamil Nadu,** India's largest spinning hub, saw **500 textile mills close** in the past two years.
  - **Tiruppur,** a major knitwear hub, experienced a **40% decline in business** in FY23.
- **Key Factors Behind Export Slump**:
  - **Geopolitical issues** and weakening demand in key markets.
  - High **raw material prices** (cotton and Man-Made Fibres - MMF).
  - **10% import duty on cotton**, making Indian cotton more expensive.
  - Disruption in **MMF prices** due to **quality control orders**.
  - Calls for removing the import duty on cotton during **April-October (off-season)** for competitive pricing.

Other Industry Challenges:

- **Changing Business Models**:
  - Growth of **direct-to-customer retailing** via e-commerce.
  - Increased focus on **sustainability (ESG)** by foreign brands, requiring suppliers to meet specific sustainability goals.
  - Shift in demand towards **comfort wear, loungewear, and athleisure**.
- **Changing Consumer Preferences**:
  - **Rural and semi-urban customers** prefer shopping at **multi-brand outlets and hypermarkets**, moving away from lesser-known brands.

What next:

- **Investment Plans**:
  - The sector is looking at **$100 billion in investments by 2030** to boost production capacity and achieve its business goals.
- **Labour and Technology**:
  - Labour costs are around **10% of production costs**, with wages of trained textile workers at **₹550/day** and unskilled workers at **₹450/day**.
  - Increasing focus on **technology adoption** and **workforce skilling** to enhance productivity and reduce wastage.

Govt notifies seed varieties suitable for rabi season after 2 months of release by PM

Sub : Geo

Sec: Eco Geo

Context:

- Prime Minister Narendra Modi launched **109 new seed varieties** in August as part of a **100-day government initiative** aimed at boosting **agricultural productivity.**

Details:

- Of these, **20 varieties** are suitable for the **rabi season**, including **wheat, gram (chana), barley, lentil, and safflower.**

- However, these varieties were only officially notified on **October 8**, after the sowing season had already begun, potentially delaying their commercial cultivation by 2-3 years. Seed breeders need this time to develop and multiply the seeds before they are available for wide-scale use by farmers.

- **Notable Rabi Seed Varieties:**

- o **Wheat**: HI 1665, HI 8840
- o **Barley**: DWRB-219
- o **Gram (Chana)**: PG 265, NbeG 1267
- o **Lentil**: PL 320, Kota Masoor 6, PSL 17
- o **Safflower**: ISF-123-sel-15, ISF 300
- o **Berseem**: JB 08-17
- o **Sugarcane**: Co 17018, CoLk 16202, CoLk 16470, CoPb 17215
- o **Maize**: APCH-2, APCH-3, IMH 230
- o **Grain Amaranth**: RMA 120, GA 8 SKNA 1407
- The seeds were approved by the **Central Sub-Committee on Crop Standards**.
- These seeds were **developed** by various research centres under **ICAR** (Indian Council of Agricultural Research) to **increase farm productivity,** with many of the varieties being **high-yielding, climate-resilient,** and **biofortified.**

Future reforms:
- The government is merging the existing **Seednet portal** with the recently launched **SATHI portal** (Seed Authentication, Traceability, and Holistic Inventory) to streamline information related to seed supply, demand, and regulatory matters. Additionally, **Krishi Vigyan Kendras (KVKs)** have been tasked with educating farmers monthly about the benefits of these new varieties to ensure awareness and increased adoption.

SATHI portal:
- **SATHI,** or **Seed Authentication, Traceability & Holistic Inventory,** strives to create a nurturing digital environment.
- It is an initiative of the **Ministry of Agriculture and Farmers' Welfare**, Govt. of India.
- It **aims** to oversee seed production, ensure quality certification, and manage distribution with utmost care.
- The **core objective** is to offer complete traceability of seeds from their inception to the hands of farmers across successive generations.

Salient features:
- GIS reports based on the Bharat Map Interface
- Provision of wallet service
- Offline-friendly and device-agnostic mobile application
- Quality inspection module for the quality check of the inspection process
- System-generated sample slip on processed verification data
- Online forwarding of the samples to the seed testing laboratory
- Issuing of tag certificate based on digital tag register

Services offered:
1. **Registration of Seed Producing Agencies:** Apply for registration or check the status of Seed Producing Agency under Seed Certification Agencies for different state
2. **Registration of Seed Processing Plants:** Apply for registration or check the status of Seed Processing Plants under Seed Certification Agencies for different state
3. **Seed Dealership License:** Any business unit can apply or check the status for a Seed Dealership license to issuing authorities for different state
4. **Download Field Inspection Report:** Can download the field inspection report uploaded by the quality inspector
5. **Trace Tag Number:** Can trace the detailed seed information from source to destination with a quality certificate

How paddy variety PR-126 became a victim of its own popularity

Sub : Geo

Sec: Eco geo

About the controversy:
- In the recent years, PR-126 has faced scrutiny due to alleged **low milling out-turn ratios (OTR),** leading to rice shellers refusing to accept this variety.
- The controversy has escalated into a political issue, with opposition parties criticizing the Punjab government's handling of paddy procurement.

- The primary issue facing PR-126 stems from the influx of **non-certified hybrid varieties** being marketed under its name. Millers have expressed concerns about these **hybrids having lower OTRs (60%-62%)** compared to PR-126's consistent 67%.
- Millers do not have a problem with PR-126 per say. Rather, they are concerned about hybrid varieties sold under the name of PR-126.

About PR-126:
- PR-126, a **short-duration** paddy variety developed by **Punjab Agricultural University (PAU),** gained popularity among farmers in Punjab since its introduction in **2016**.
- It was favoured for its **shorter growth cycle, high yield, lower pesticide needs and excellent OTR.**
- It offers an average yield of over **30 quintals per acre**.
- In the 2023-2024 season, PR-126 was cultivated on approximately 8.59 lakh hectares, constituting about **33% of non-Basmati paddy** cultivation in Punjab and is expected to increase to 44% this year.

Advantages of PR-126:
- Punjab has seen a record-high area under paddy cultivation, roughly 32 lakh hectares, in the 2023-24 and 2024-25 seasons, but the state is facing a severe groundwater crisis.
- Shifting to paddy varieties which can be grown in a shorter duration likely offers the best **solution for the water crisis**. This is where PR-126 comes in.
- It gives farmers **more time to manage stubble**, reducing the need for burning.

Victim of its own popularity:
- This year, the demand for PR-126 was huge, and when enough seed wasn't available, seed and pesticide companies took advantage of the situation by selling hybrid varieties under the PR-126 name.

Out-turn ratio (OTR):
- out-turn ratio refers to the post milling yield of a crop.
- The out-turn ratio of rice from paddy is the percentage of rice produced from a given amount of paddy.

Who are Arhtiyas:
- Arhtiyas are **traditional commission agents or middlemen** in the Indian agricultural market, primarily responsible for facilitating the sale and purchase of agricultural produce between farmers and buyers.
- They play a crucial role in the marketing of crops, especially in states like Punjab and Haryana.

India's Coking Coal Imports Surge to Six-Year High Driven by Russian Supplies and Increased Steel Production

Sub : Geo

Sec: Eco geo

Why in News

India's coking coal imports have reached a **six-year high** due to a **significant increase in Russian shipments** and **growing domestic steel production.** The shift highlights **India's diversification** in sourcing away from traditional suppliers like Australia.

Rising Steel Production and Coking Coal Demand:

India's **crude steel production** for the **first six months of FY25** was approximately **73 MT, a 4% year-on-year increase.** The **rise in steel production has driven higher demand for coking coal,** essential for steel manufacturing.

Shift in Coking Coal Supply Sources:

India has capitalized on **discounted Russian coking coal,** with imports from Russia soaring by **200% over recent years.** Major Indian steel producers, including SAIL and JSW, have increased Russian coal imports, adjusting their blast furnaces accordingly.

Australia's share in India's coking coal imports fell to 54% (16 MT out of 29.6 MT) in H1FY25, the lowest in six years. **Australian coking coal accounted for 80% of India's imports in H1FY22** but has **gradually reduced** as India diversifies sources.

India's coking coal imports from other traditional suppliers like **Mozambique and Indonesia** have shown slight increases.

About Coking Coal:

Top Suppliers: **Australia (16 MT),** Russia (4 MT), United States (4.3 MT)

Coking coal is a type of coal that is important in **making high-quality coke.** It is also called **metallurgical coal.**

This substance is an **essential fuel** and is **useful as a reactant in the blast furnace** process **of primary steelmaking.** Therefore, the demand for this type of coal is parallel to that of steel.

Coking coal has a **low ash content, low moisture content and low sulphur and phosphorous contents.**

We can categorize **coking coal as a type of bituminous coal** depending on the chemical composition.

During the process of coking (production of coke from coking coal), the **material tends to swell and its volume increases.**

The ability of coking coal to form coke relates to its physical properties such as the rank of coal. In contrast to coking coal, **thermal coal cannot produce coke** when the material is heated.

Experts urge a new global pact at COP16 to safeguard boreal and temperate forests

Sub: Geo

Sec: Economic Geography

Urgent Call for Focus on Northern Forests:

- During the **16th Conference of Parties (COP16)** to the **Convention on Biological Diversity (CBD)** in **Cali, Colombia,** experts highlighted the critical importance of the **world's Northern forests** for **biodiversity, indigenous rights,** and **climate change mitigation.**

Key Roles of Northern Forests:

- **Forest Coverage:** Northern forests, particularly in **boreal** and **temperate regions of Europe, North America,** and **Russia,** comprise around **30%** of global forest cover.
- **Carbon Sinks:** These forests play a crucial role in absorbing **atmospheric CO_2**, helping mitigate climate change.
- **Protection Gap:** Currently, **only 10%** of Northern forests are protected, falling short of the **global target of 18%**. This leaves them vulnerable to unsustainable practices like industrial logging.

Disparities in Forest Conservation Efforts:

- **Tropical forests** receive significant attention and funding compared to **Northern forests,** which are often overlooked despite their ecological importance.
- This disparity reflects a historical focus on economic development in the Global North, leading to insufficient protective measures for Northern forests.

Main Threats to Northern Forests:

- **Industrial Logging:**
  - **Habitat Degradation:** Clear-cutting practices disrupt ecosystems, reduce biodiversity, and create homogeneous plantations, which are less resilient.
  - **Carbon Emissions:** Logging turns these vital carbon sinks into carbon sources, undermining climate goals. Since **1976,** logging has affected over **35.54 million acres** of **boreal forests.**
  - **Old-Growth Forest Loss:** In **Sweden**, between **2003** and **2019, 20%** of forests cleared were old-growth, raising sustainability concerns.

Feature	Tropical Forests	Temperate Forests	Boreal Forests (Taiga)
Location	Equatorial regions (e.g., Amazon, Congo, Southeast Asia)	Mid-latitudes (e.g., Eastern US, Western Europe)	High-latitudes (e.g., Canada, Russia, Scandinavia)
Climate	Warm, humid, consistent year-round	Moderate, with distinct seasons	Cold winters, mild summers, low precipitation
Average Temperature	20–30°C (68–86°F)	10–15°C (50–59°F)	-5–5°C (23–41°F)
Rainfall	High (2000–4000 mm annually)	Moderate (750–1500 mm annually)	Low (300–850 mm annually)
Biodiversity	Extremely high; supports vast species diversity	Moderate diversity	Lower diversity; fewer tree and fauna species
Dominant Tree Species	Broadleaf evergreens (e.g., mahogany, rubber trees, kapok)	Deciduous (e.g., oak, maple) and evergreen (e.g., pine)	Conifers (e.g., spruce, pine, fir, larch)
Fauna	Jaguars, sloths, toucans, poison dart frogs, orangutans	Black bears, deer, wolves, foxes, owls, squirrels	Brown bears, moose, lynxes, wolves, snowshoe hares
Soil Fertility	Generally low; rapid nutrient cycling	Moderate; richer in nutrients than tropical soils	Poor; acidic, nutrient-poor due to cold climate
Carbon Storage	High; major global carbon sinks	Moderate	High; significant carbon storage in trees and soil
Threats	Deforestation, agriculture, mining	Logging, agriculture, urban expansion	Logging, mining, climate change

Conservation Focus	High; receives global attention and funding	Moderate	Increasing; often overlooked but gaining attention
Economic Importance	Timber, medicine, tourism, ecosystem services	Timber, recreation, ecosystem services	Timber, paper, ecosystem services
Role in Climate Change	Vital carbon sink, regulates global rainfall patterns	Important for local climate regulation	Significant carbon sink, affects Arctic climate dynamics

Revitalization of the Six-Decade-Old Canal System of Hirakud Dam

Sub: Geo

Sec: India Physical geo

Why in News

The **Odisha government** has allocated **₹855 crore** for the renovation of the **six-decade-old canal system** connected to the **Hirakud Dam.** The renovation is expected to significantly benefit farmers in districts like **Sambalpur, Subarnapur, Bargarh, and Balangir** by improving irrigation efficiency and reducing water wastage.

About Hirakud Dam

Hirakud Dam is situated around 15 km from **Sambalpur** in Odisha, across the **Mahanadi River**.

World's Longest Earthen Dam: It spans **26 km** (16 miles), making it the **longest earthen dam** globally.

Hirakud Reservoir: The dam creates **Asia's largest man-made lake**, also known as **Hirakud Lake**.

The main dam extends **4.8 km**, connecting **Laxmidungri** on the left and **Chandili Dunguri** on the right.

One of India's First Multipurpose Projects: Built post-independence, construction started in **1948** and completed in **1953**.

Designed to regulate **Mahanadi River's flow** and mitigate flooding.

Opened by Prime Minister **Jawaharlal Nehru** in **1957**.

Irrigation: Provides irrigation to **436,000 hectares** in the **Mahanadi delta**.

Supports irrigation of **1,08,385 hectares** of Rabi crops and **1,55,635 hectares** of Kharif crops in **Bolangir, Subarnapur, Bargarh, and Sambalpur** districts.

Power Generation: The dam has an installed capacity of **359.8 MW**.

Flood Protection: Safeguards **9,500 sq km** in **Cuttack and Puri** districts from floods.

Renovation of Key Canals:

The project will focus on revamping the **Bargarh main canal** and **Sasan main canal**, which are currently in a dilapidated state. In addition to the main canals, various **distributaries** will also be repaired to make them functional again, ensuring smooth water flow throughout the network.

Mahanadi river:

The Mahanadi River is a **major river in East Central India.**

Mahanadi is also known for the **Hirakud Dam** which was the first major multipurpose river valley project after India's independence in 1947.

The river flows through the states of **Chhattisgarh and Odisha** and before finally ending in the **Bay of Bengal.**

Origin: Nagri-Sihawa, Dhamtari, Dandakaranya, **Chhattisgarh, India.**

Mouth: False Point, Jagatsinghpur, Delta, Odisha, India

Tributaries:

Left- Seonath, Mand, Ib, Hasdeo, Kelo

Right- Ong, parry, Jonk, Telen

Tamil Nadu Declares Heatwave a State-Specific Disaster; Announces ₹4 Lakh Ex-Gratia for Heat-Related Fatalities

Sub :Geo

Sec: Indian Physical

Why in News

In a landmark decision, the **Tamil Nadu government has declared heatwaves as a State-specific disaster.** This announcement includes a **compensation policy** providing an **ex-gratia payment of ₹4 lakh to families** of those who succumb to **heat-related causes.**

Tamil Nadu's Heatwave Declaration:

Tamil Nadu is one of the first states in India to officially recognize **heatwaves** as a **disaster,** enabling state authorities to **rapidly deploy relief measures.**

Use of State Disaster Response Fund (SDRF): The SDRF will be utilized to **support relief measures** aimed at reducing the impact of extreme heat on affected populations.

Compensation Amount: The Tamil Nadu government has **pledged ₹4 lakh in ex-gratia compensation for families** of individuals who die due to heat-related causes. This includes fatalities among those actively involved in heatwave relief operations.

Families of heatwave victims, particularly from vulnerable groups, are eligible to receive compensation to ease the financial burden due to such unforeseen losses.

What Are Heat Waves?

A **heat wave** is a prolonged period of **excessively high temperatures,** significantly above the average maximum temperature of a region, and is often associated with **dry, stagnant atmospheric conditions.**

This phenomenon typically affects **North-Western parts of India during the summer season,** especially from **March to June**, though heat waves can occasionally extend into **July**.

The extreme temperatures can **lead to physiological stress in humans, posing serious health risks and potentially leading to fatalities.**

Criteria for Heat Waves by the Indian Meteorological Department (IMD):

Temperature Thresholds for Heat Wave Declaration:

- **Plains**: A heat wave is declared when the maximum temperature reaches **at least 40°C**.
- **Hilly Regions**: In hilly regions, the threshold is lower, at **30°C**.

Departure from Normal Temperature:

- **Normal Maximum Temperature ≤ 40°C**:
    - **Heat Wave**: Departure from normal temperature by **5°C to 6°C**.
    - **Severe Heat Wave**: Departure from normal temperature by **7°C or more**.
- **Normal Maximum Temperature > 40°C**:
    - **Heat Wave**: Departure from normal temperature by **4°C to 5°C**.
    - **Severe Heat Wave**: Departure from normal temperature by **6°C or more**.

Extreme Heat Condition: Regardless of the normal maximum temperature, when the actual maximum temperature reaches **45°C or more**, a heat wave is declared.

Increased Intensity and Frequency: With the influence of **climate change**, peak daily temperatures are rising, resulting in **longer, more intense heat waves** globally. These elevated temperatures contribute to harsher atmospheric conditions that can exacerbate heat waves, particularly in tropical regions like India.

Heat waves in India are increasing not only in **frequency** but also in **intensity** with each passing year. This trend poses heightened risks for human health, often leading to more casualties and a greater strain on healthcare systems.

Causes and Contributing Factors of Heat Waves:

Urban Heat Island Effect: Cities often have higher temperatures due to human activities, **concrete structures, and limited vegetation, creating 'urban heat islands'** that absorb and retain heat.

Climate Change: Rising **global temperatures have intensified heat waves,** making them more frequent and severe, with longer durations.

Atmospheric Circulation Patterns: Stagnant high-pressure systems can trap warm air over regions, leading to sustained high temperatures.

Measures for Coping with Heat Waves

Public Awareness and Alerts: The IMD issues **heat wave warnings** to inform the public, enabling timely precautions.

Cooling Centers and Shelters: Designated **areas provide air-conditioned spaces,** drinking water, and medical aid.

Hydration and Protective Measures: Individuals are **encouraged to stay hydrated,** limit outdoor activities, and seek shade or cool areas to mitigate the effects of extreme heat.

Government Initiatives: Authorities implement **heat action plans** in affected regions, providing resources and medical assistance to prevent heatwave casualties.

High-Level Committee to Decide on L3 Classification for Wayanad Landslides Disaster

Sub : Geo

Sec: Indian physical geo

Why in News

The **Union Government** has informed the **Kerala High Court** that a **high-level committee** will make a decision within two weeks on categorizing the July 30 **Wayanad landslides as a Level 3 (L3) disaster.** This classification could pave the way for enhanced relief measures, including potential international aid.

Wayanad Landslide: The landslides occurred on **July 30 in the Wayanad district of Kerala,** an area prone to **landslides** due to **heavy monsoon rains** and its **mountainous terrain.**

Disaster Classification in India

India's disaster classification system, managed by the **National Disaster Management Authority (NDMA)** under the **Ministry of Home Affairs,** categorizes disasters to streamline response efforts. The categories are based on disaster severity and the scale of response required.

National Disaster Management Authority (NDMA) under the **Disaster Management Act, 2005**.

Categories of Disasters:

Level 1 (L1) Disaster: Small-scale disaster managed at the **district level**.

Examples: Local floods, minor landslides, fires.

Management: Handled by **local and district authorities** with minimal external assistance.

Level 2 (L2) Disaster: Medium-scale disaster needing **state-level** intervention and resources.

Examples: Severe droughts, large floods, major landslides.

Management: **State government** handles with some central government support.

Level 3 (L3) Disaster: Large-scale disaster exceeding state capacity, needing **national and possibly international** aid.

Examples: Cyclones, earthquakes, tsunamis.

Management: **Central government** leads response, including NDMA and National Disaster Response Force (NDRF).

If the Wayanad landslide is classified as an L3 disaster, the **State would gain access to various forms of relief and rehabilitation assistance, including international aid.** This support would enable more comprehensive efforts in disaster recovery, infrastructure restoration, and humanitarian relief for affected communities.

Suggestions for Improved Disaster Preparedness:

The High Court discussed the **need for parametric insurance to provide financial protection against natural disasters.**

A parametric insurance scheme, developed in collaboration with the Union Government and private insurers, could **mitigate financial constraints faced by the State during disaster recovery.**

The court suggested **exploring insurance models that cover potential natural disasters,** thereby ensuring quick compensation and **easing the financial burden on the State post-disaster.**

What is the Z-Morh project in Kashmir, where 7 were killed by militants?

Sub: Geo

Sec: Mapping

Z-Morh Tunnel: Key Details and Importance:

- The **Z-Morh tunnel** is a **critical infrastructure project** in **Jammu and Kashmir,** recently in the spotlight due to a militant attack on October 20, 2024.

What is the Z-Morh Tunnel?

- **Location**: It connects the **Sonamarg** tourist destination with **Kangan town** in **Ganderbal district, central Kashmir.**
- **Purpose**: Provides **all-weather connectivity** to **Sonamarg,** situated on the **Srinagar-Leh highway**.
- **Length**: 6.4 kilometers.
- **Name Origin**: Derived from the **Z-shaped road stretch** near its construction site in **Gagangir village**, near Sonamarg.
- Proposed by the **Border Roads Organisation (BRO)** in **2012**.
- The **contract** was initially awarded to **Tunnelway Ltd.,** but later retendered and awarded to **APCO Infratech**.
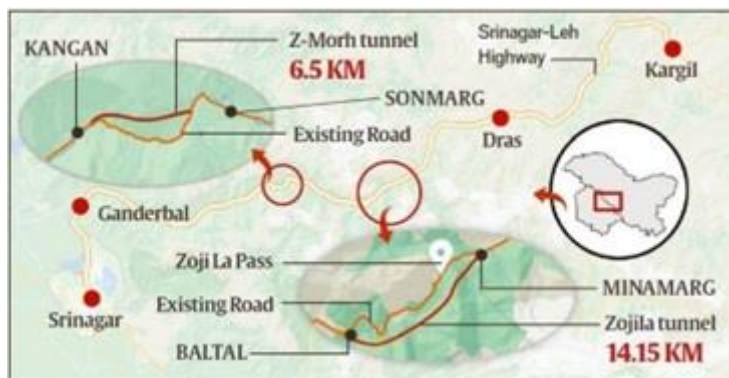
Why Was the Z-Morh Tunnel Needed?

- The tunnel is located at over **8,500 feet,** a region prone to **heavy snow and avalanches during the winter,** leading to frequent road closures.
- The road to **Sonamarg** remains closed for most of the winter due to adverse weather conditions, and the **tunnel ensures year-round access.**

Strategic Importance:

- **Part of a Larger Project**: The **Z-Morh tunnel** is a key component of the **Zojila tunnel project**, designed to provide **all-weather connectivity** between **Srinagar** and **Ladakh.**
- **Military Access**: Crucial for **India's defense strategy,** providing fast and reliable road access to **Ladakh**, particularly for military personnel stationed in sensitive areas like **Siachen Glacier** and **Eastern Ladakh**, where **Indian forces** face both **Pakistan** and **China.**
- **Reduced Air Dependency**: All-weather connectivity via the **Z-Morh tunnel** reduces the reliance on **air maintenance** for army supplies and troop movements, cutting costs and preserving aircraft life.

Connection to the Zojila Tunnel:

- The **Zojila tunnel**, under construction at an altitude of around **12,000 feet**, will connect **Sonamarg** in Kashmir to **Drass** in **Ladakh.** This strategic tunnel, expected to be completed by **December 2026,** combined with the **Z-Morh tunnel**, will provide year-round road connectivity for civilian and military use.

Former Tripura CM Biplab Deb Calls for Urgent Renovation of Border Fencing Amid Security Concerns

Sub : Geo

Sec: Mapping

Why in News

Former Tripura Chief Minister and Lok Sabha MP, Biplab Kumar Deb, has raised concerns about the **deteriorated border fencing along the Bangladesh border,** urging the Union government for immediate renovation to **ensure security amidst rising instability in Bangladesh.**

Border Security:

Tripura shares an 856 km border with Bangladesh, which includes vulnerable stretches due to old fencing.

Regional Concerns: Political instability in Bangladesh, including potential changes in the Sheikh Hasina government, has **heightened security concerns along this border.**

Deterioration of Fencing: Existing **barbed wire fencing** along the **Tripura-Bangladesh border** has degraded, leading to **security risks.**

He suggested **increasing the BSF presence along the border to strengthen surveillance** and prevent any potential security breach due to the current situation in Bangladesh.

Strategic Implications:

Regional Stability: With the political scenario in Bangladesh uncertain, reinforced fencing and additional border security could **prevent illegal activities and bolster the region's stability.**

National Security: Ensuring a **well-guarded border** in Tripura is critical for **India's national security,** given the proximity to **potential areas of unrest across the border.**

About Bangladesh–India border:

The Bangladesh–India border, known locally as the **International Border (IB),** is an international border running between Bangladesh and India.

Bangladesh and India share a 4,096-kilometre-long (2,545 mi) international border, the **fifth-longest land border in the world**, including 262 km (163 mi) in **Assam,** 856 km (532 mi) in **Tripura**, 318 km (198 mi) in **Mizoram**, 443 km (275 mi) in **Meghalaya**, and 2,217 km (1,378 mi) in **West Bengal**.

The **Border Security Force (BSF) of India** and the **Border Guards Bangladesh (BGB)** of Bangladesh are involved in the patrolling of the border area.

The border **divides the Sundarbans mangrove forest and the Ganges delta region** and is crisscrossed by many rivers.

Ocean warming rate nearly doubled since 2005: report

Sub: Geo

Sec: Oceanography

Context:

- A recent report by the European Union's **Copernicus Monitor** says that the **rate at which oceans are warming has almost doubled since 2005** due to human-caused climate change.

Findings of the report:

- Ocean warming has increased continuously since the 1960s but sharply accelerated after 2005.
- In the last two decades, the rate of warming has nearly doubled, increasing from a long-term average of **58 watts per m² to 1.05 watts per m².**
- In 2023, more than 20 percent of the world's oceans experienced at least one severe to extreme marine heatwave.
- These findings align with an **IPCC report** which said that since 1970, around **90% of excess heat trapped in the atmosphere** due to the release of carbon dioxide and other greenhouse gases has been **absorbed in the oceans**.

Consequences of warmer oceans:

- The report highlighted the impacts of a warming planet on the oceans, which cover **70% of the Earth's surface** and play a crucial role in regulating the climate.
- Warmer oceans intensify **storms and other extreme weather events, and alter rainfall patterns**.
- Marine heatwaves have **ripple effects for marine life and fisheries**.
- Unprecedented sea ice loss and deep ocean heat storage.

About European Union's Copernicus Atmosphere Monitoring Service:

- Copernicus is the **Earth observation component** of the European Union's Space programme.
- It provides comprehensive **data on ocean conditions and climate monitoring**.
- **Focus Areas:** Ocean temperature monitoring, tracking marine heatwaves, observing sea ice loss and analysing ocean heat storage.

About IPCC:

- The **Intergovernmental Panel on Climate Change** is an **intergovernmental body** of the United Nations.
- It was set up by **World Meteorological Organization and the United Nations Environment Programme** in 1988.
- It aims to advance scientific knowledge about climate change caused by human activities.
- The IPCC **does not conduct its own research**, rather compiles scientific data from research conducted by other institutions into its Assessment reports.
- **Sixth Assessment Report (AR6), which was recently released,** highlighted the urgency of climate action.

Nearby river contributes to the rise of Mount Everest, says new study

Sub :Geo

Sec: Oceanography

Context:

- **Mount Everest,** the **world's tallest mountain at 8,849 meters**, is **growing faster than expected.**
- A recent study suggests that over the past **89,000 years**, it has grown **15 to 50 meters higher than anticipated.**
- The reason: A nearby river is playing a crucial role.

Details:

- The **Arun River,** located **75 km** from **Everest**, is eroding **rock** and **soil** at the **mountain's base.**
- This erosion is causing **Everest** to **rise by up to 2 mm per year.**
- The process contributing to this growth is called **"isostatic rebound."**

What is Isostatic Rebound?

- **Isostasy** (Greek isos **"equal,"** stasis **"stand still"**) is a term in geology to describe the **state of mass balance (equilibrium)** between the **Earth's crust** and **upper mantle.**
- It describes a condition in which the **mantle** tends to **balance** the **mass of the crust** in the **absence of external forces**.

- Imagine the Earth's crust as a floating object on a semi-liquid layer. When weight is removed from the **surface** (like eroded rock), the **crust rises slightly,** similar to a boat rising when cargo is unloaded.

The River's Role:

- About **89,000 years ago**, the **Arun River** merged with the **Kosi River**.
- This merger led to **increased erosion**, removing large amounts of **rock and soil.**
- The reduced weight in the region near Everest allowed the mountain to rise more quickly.
- **Study Findings:**
    - **Isostatic rebound** accounts for about **10%** of **Everest's annual uplift rate.**
    - Neighbouring peaks like **Lhotse** and **Makalu** are also affected.

However, some experts are skeptical:

- The **timing of the river merger** is uncertain.
- Dating river deposits and erosion rates is challenging.
- Some geologists believe **river erosion** may have little impact on **mountain uplift**.

Arun river:

- It is a **transboundary river** that is part of the **Koshi** or **Sapta Koshi river** system in **Nepal.**
- It **originates** in the **Tibet Autonomous Region** of the **People's Republic of China** where it is called the **Phung Chu** or **Bum-chu.**
- **Mouth:** Confluence with **Sun Koshi** and **Tamur River** to form **Sapta Koshi**
- **Tributaries:**
    - **Left-** Yeru Tsanpo, Trakar-chu
    - **Right-** Barun River

World's water cycle getting unpredictable, says UN study
Sub: Geo
Sec: Oceanography
Context:

- Increasingly intense floods and droughts are a **"distress signal"** of what is to come as climate change makes the planet's **water cycle ever more unpredictable**, the United Nations said.

Details:

- Last year, the **world's rivers** were their **driest** for more than **30 years, glaciers** suffered their **largest loss of mass in half a century,** and there were also a "significant" number of **floods**.
- Last year marked the **hottest year on record,** characterized by **extreme weather events** such as **prolonged droughts** and **floods** worldwide. These extremes were driven by both naturally occurring phenomena like **La Niña** and **El Niño**, as well as **human-induced climate change**.
- A warmer atmosphere holds more moisture, leading to more intense rainfall, while faster evaporation worsens drought conditions.

Water resources are either excessive or insufficient, creating severe challenges:

- **Africa** was the most impacted continent in terms of human casualties.
- In **Libya**, catastrophic floods caused by dam collapses in **September 2023** resulted in over **11,000 deaths** and affected **22% of the population**.
- Floods also devastated regions like the **Greater Horn of Africa**, **Democratic Republic of Congo**, **Rwanda**, **Mozambique**, and **Malawi**.
- Currently, **3.6 billion people** experience insufficient access to **fresh water** at least once a month, with this figure projected to rise to over **five billion by 2050**.
- **Massive Glacier Melt**:
    - From **September 2022 to August 2023**, glaciers lost over **600 billion tonnes of water**, the largest melt observed in the past 50 years.
    - This rapid melt threatens long-term water security for millions, but urgent action remains lacking.

Water cycle:

- The **hydrologic cycle,** also known as the **water cycle,** explains the journey taken by water molecules as they go from the surface of the Earth to the atmosphere and back again, occasionally going below the surface.
- At its core, the water cycle is the motion of the water from the ground to the atmosphere and back again.

- **Water** travels through many different layers of the earth's surface, including the **oceans, glaciers, and lakes,** as well as simultaneously (or more slowly) moving through the **soil and rock layers** below the surface. These are complex paths.
- The water is afterwards released back into the **atmosphere.**
- The fact that the hydrologic cycle has no beginning and no end is a basic aspect of it.

Key Processes in the Water Cycle:

- **Evaporation**:
    o Liquid water turns into gas (water vapour).
    o Requires energy from the sun, atmosphere, or other sources (e.g., body heat through sweating).
    o Cooling effect, as seen after swimming or showering.
- **Transpiration**:
    o Water evaporates from plants via small openings called stomata, mostly on leaf undersides.
    o Depends on atmospheric humidity and soil moisture.
    o **99.9%** of water from transpiration is released into the atmosphere; only **1%** aids plant growth.
- **Condensation**:
    o Water vapour turns back into liquid, forming clouds or dew.
    o Occurs when the air temperature cools to the dew point.
    o Releases heat, contributing to weather phenomena like hurricanes.
- **Precipitation**:
    o When condensation particles collide and grow too large, they fall as rain, snow, sleet, or hail.
    o Provides Earth's main source of fresh water, with an average of 38.5 inches (980 mm) of precipitation annually.
- **Runoff**:
    o Excess water from precipitation flows over land, forming rivers and lakes.
    o Some runoff evaporates; the rest returns to oceans.
    o In closed lakes (with no outflow), evaporation leads to increased salinity (e.g., Dead Sea, Great Salt Lake).

Fourth global coral bleaching widest and fastest on record

Sub :Geo

SEC: Oceanography

Context:

- The ongoing **fourth global coral bleaching event (GCBE4),** which commenced in **January 2023**, is now the most extensive and severe event recorded, surpassing previous bleaching levels observed during the period of 2014-2017 by over 11 percent, according to the **United States National Oceanic and Atmospheric Administration (NOAA)**.
- In response to the widespread coral bleaching, scientists from the UN have called for a **special emergency session** on coral reefs during the upcoming **Convention on Biological Diversity summit (COP16) in Cali, Colombia**.

Coral bleaching:

- When corals face stress by changes in conditions such as temperature, light, or nutrients, they **expel the symbiotic algae zooxanthellae** living in their tissues, causing them to turn completely white. This phenomenon is called coral bleaching.
- The **pale white colour** of bleached corals is of the translucent tissues of **calcium carbonate** which are visible due to the loss of pigment producing zooxanthellae.
- If heat-pollutions subside in time, over a few weeks, the zooxanthellae can come back to the corals and restart the partnership but **severe bleaching and prolonged stress** in the external environment can lead to **coral death**.

About GCBE4:

- GCBE4 has been characterized by severe and intense bleaching recorded in **nearly half the time compared to GCBE3**, which lasted three years and affected over 65.7 percent of the world's coral reefs.
- GCBE3 was previously noted as the longest, most widespread, and damaging event on record.
- The event has led to confirmed reports of mass coral bleaching from **74 countries** and territories across both hemispheres, impacting regions in the Atlantic, Pacific, and Indian Oceans.
- At least **77 per cent of global reef areas** and 99.9 per cent of the coral reef areas in the Atlantic Ocean have experienced bleaching-level heat stress during this event.
- The full scale of its impact of the event may not be known until a few years later as scientists would need to conduct extensive assessments.

Coral mortality:

- If corals stay bleached, they can become energetically compromised and ultimately die.
- When corals die or their growth slows, complex reef habitats start disappearing and can eventually erode to sand.
- Coral mortality can occur in a matter of days-to-weeks. However, corals can also die 1-2 years after bleaching because they become **immunocompromised** by the heat stress and thus become far more **susceptible to disease-driven mortality.**
- GCBE4 has seen severe mortality of **elkhorn and staghorn corals** in certain locations of the Caribbean Sea.
- During the **2005 bleaching event** in the **US Virgin Islands**, many corals survived the heat, but then went on to die from subsequent disease outbreaks over the next two years.

Role of climate patterns:

- Historically, **strong El Nino** events have been linked to **severe bleaching**, but recently, large-scale and severe events have occurred during La Nina periods.
- This suggests that ocean temperatures have increased to the point whereby large-scale bleaching events may now occur during any phase of El Nino-Southern Oscillation (ENSO),

Coral Triangle at risk: new report highlights fossil fuel threats and impacts on biodiversity and communities

Sub: Geo

Sec: Oceanography

The Coral Triangle:

- The **Coral Triangle,** often called the **"Amazon of the seas,"** spans over **10 million square kilometres** across **Indonesia, Malaysia, Papua New Guinea, Singapore, the Philippines, Timor-Leste**, and the **Solomon Islands.**
- It is home to **76%** of the **world's coral species** and supports the livelihoods of over 120 million people.

Report Highlights at COP16

- **Event:** 16th Conference of Parties (COP16) to the Convention on Biological Diversity (CBD) on October 26
- **Report Title:** *Coral Triangle at Risk: Fossil Fuel Threats and Impacts* by Earth Insight and SkyTruth

Fossil Fuel Impact on the Coral Triangle:

- **Current Activities:**
  - Over **100 offshore oil and gas blocks** are operational, covering 120,000 square kilometers (1% of the Triangle)
  - 450+ blocks under exploration, potentially impacting 1.6 million square kilometers (16% of the Triangle)
- **Critical Habitats Threatened:**
  - **Coral reefs:** 24% affected
  - **Seagrass areas:** 22% affected
  - **Mangroves:** 37% affected
- **Oil Pollution:**
  - **793 oil slicks** have been detected since **2020**, mostly from bilge dumping by ships, impacting 24,000 square kilometers.
  - **Notable Spill:** The **Princess Empress oil spill (2023)** affected over **20** Marine Protected Areas (MPAs) and 21,000 families, with damages estimated at 3.8 billion Philippine pesos (~$68.3 million).
- **LNG Infrastructure Expansion:**
  - **$30 billion** invested in **LNG terminals** from **2016 to 2022**; **19 LNG terminals** are active, with more planned.

Key Environmental Threats from Fossil Fuel Expansion:

- **Noise Pollution:** Disrupts marine life, especially species like whales and dolphins that depend on sound.
- **Habitat Overlaps:**
  - 16% of MPAs overlap with oil and gas blocks, threatening 80 fully-covered MPAs.
  - 15 of the 19 LNG terminals are within 10 kilometers of sensitive habitats.
- **Water Pollution:** Wastewater from LNG terminals contains chemicals that can trigger toxic algal blooms and degrade water quality.

Impact on Local Communities

- Oil spills and fossil fuel infrastructure disrupt livelihoods, particularly for fisherfolk and coastal residents.
- Health Risks: Residents near spills experience nausea, dizziness; toxic fumes have led to school closures.
- Cultural Threats: In South Bali, LNG projects are seen as a risk to indigenous sites and cultural heritage.

Particularly Sensitive Sea Areas (PSSA):

- **PSSA** is an area that needs special protection through action by **IMO** because of its significance for **recognised ecological or socio-economic or scientific reasons** and which may be vulnerable to damage by international maritime activities.
- The **criteria** for the identification of **particularly sensitive sea areas** and the **criteria** for the designation of **special areas** are not mutually exclusive.
- In many cases a **Particularly Sensitive Sea Area** may be identified within a **Special Area** and vice versa.
- **Criteria for designating an area as PSSA:**
  - **Ecological criteria,** such as unique or rare ecosystem, diversity of the ecosystem or vulnerability to degradation by natural events or human activities;
  - **Social, cultural and economic criteria,** such as significance of the area for recreation or tourism; and
  - **Scientific and educational criteria,** such as biological research or historical value.
- When an area is approved as a **particularly sensitive sea area,** specific measures can be used to control the maritime activities in that area, such as **routeing measures, strict application of MARPOL discharge and equipment requirements for ships,** such as oil tankers; and installation of **Vessel Traffic Services (VTS)**.
- **List of adopted PSSAs:**
  - The Great Barrier Reef, Australia (designated a PSSA in 1990)
  - The Sabana-Camagüey Archipelago in Cuba (1997)
  - Malpelo Island, Colombia (2002)
  - The sea around the Florida Keys, United States (2002)
  - The Wadden Sea, Denmark, Germany, Netherlands (2002)
  - Paracas National Reserve, Peru (2003)
  - Western European Waters (2004)
  - Extension of the existing Great Barrier Reef PSSA to include the Torres Strait (proposed by Australia and Papua New Guinea) (2005)
  - Canary Islands, Spain (2005)
  - The Galapagos Archipelago, Ecuador (2005)
  - The Baltic Sea area, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden (2005)
  - The Papahānaumokuākea Marine National Monument, United States (2007)
  - The Strait of Bonifacio, France and Italy (2011)
  - The Saba Bank, in the North-eastern Caribbean area of the Kingdom of the Netherlands (2012)
  - Extension of Great Barrier Reef and Torres Strait to encompass the south-west part of the Coral Sea (2015)
  - The Jomard Entrance, Papua New Guinea (2016)
  - Tubbataha Reefs Natural Park, the Sulu Sea, Philippines (2017)
  - North-Western Mediterranean Sea, France, Italy, Monaco and Spain (2023)

History

Megalithic Burial Excavations Begin in Hanur: Unearthing the Iron Age Heritage

Sub: History

Sec: Ancient History

Why in News

Excavations have commenced at a significant megalithic burial site in **Doddalathur village, located in Hanur taluk of Chamarajanagar district, Karnataka.** This excavation is a joint initiative led by the **University of Mysore and the Mythic Society, Bengaluru,** aiming to uncover the rich **Iron Age heritage of South India.** The project also serves as a training ground for archaeology students.

About Excavation Site

The excavation is taking place in **Doddalathur village**, situated in a valley formed by the **Male Mahadeshwara Hill** ranges in **Hanur taluk, Chamarajanagar district, Karnataka.**

The site is believed to date back to the **Megalithic Period**, also known as the **Iron Age**, which is roughly placed between **1200 BCE and 300 CE** in South India.

The site was first discovered in **1961** by **C. Krishnamurti** of the **Archaeological Survey of India (ASI)**.

The village once had **over 1,000 megalithic burials**, but due to agricultural expansion, settlement, and land development activities, many burials have been disturbed or destroyed. However, a significant number of burials still remain intact, offering potential for further excavation.

Past Excavations in the Region: In **2021** and **2022**, the Department of Ancient History and Archaeology excavated the **Budipadaga site**, located about **20 km southwest** of **Doddalathur.**

Budipadaga is a **habitation-cum-megalithic burial site**, offering similar archaeological value.

Megalithic culture:

The term **"Megalith"** is derived from the Greek words **"mega" (large) and "lithos" (stone)**, meaning large stone structures, often associated with burials.

While megalith is often used to describe a **single piece of stone**, it also can be used to denote **one or more rocks hewn in a definite shape** for special purposes.

Megalithic culture refers to a period characterized by the use of large stones for **monuments and burial practices**.

Megaliths in India are dated before **3000 BC**, with recent findings dated back to **5000 BC in southern India**.

Coincides with the Iron Age in the Indian subcontinent.

Geographical Spread: Found extensively in peninsular India, especially in states like **Maharashtra, Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh**. They are also found in the upper Indus valley and central India.

Types of Megaliths:

Menhirs: Single **standing stones,** often for commemorative or religious purposes.

Dolmens: A **table-like structure** formed by placing a **large flat stone** on top of upright stones, used as burial sites.

Cairns: Stone **heaps or piles** used to mark graves.

Stone Circles: Circular arrangements of stones around burial sites.

Capstone style: Single megaliths placed **horizontally, often over burial chambers,** without the use of support stones.

Cist: A small stone-built **coffin-like box or ossuary** used to hold the bodies of the dead.

Iron Age and Settlement Patterns: The period marked the introduction and widespread use of **iron tools and weapons**, leading to advancements in agriculture, warfare, and settlement development.

Megalithic Burials: Characteristic of the Iron Age, these burials used **large boulders** (megaliths) in circular patterns, indicating complex burial practices and social structures.

Iron Age settlements were often located in **fertile valleys** and near **hilly regions** (e.g., Male Mahadeshwara Hills), with proximity to resources being a key factor.

The Iron Age revolutionized **agriculture and trade**, enabling more permanent and widespread settlements across **South India**.

ASI Completes Epigraphy Work on Ancient Inscriptions in Thirukurungudi Temples

Sub: History

Sec: Medieval History

Why in News

The **Epigraphy Division of the Archaeological Survey of India (ASI)** has recently completed the **estampage method** of copying ancient inscriptions from three significant temples in **Thirukurungudi, Tirunelveli district, Tamil Nadu.** These inscriptions provide valuable insights into the region's history, particularly during the **Pandya** and **Vijayanagara** periods.

Temples Involved: The inscriptions were copied from three temples:

Nambi Rayar Temple

Thirumalai Nambi Temple

Aniliswarar Temple

Inscriptions Collected: Approximately **25 inscriptions** were copied over a period of **15 days** using the **estampage method**.

Estampage Method:

A technique used by archaeologists to replicate **stone inscriptions** for detailed study.

Process: The inscribed stone is cleaned using a brush.

Paper Application: Pre-soaked **maplitho paper** is applied to the stone surface to capture the engravings.

Inking: Once the paper dries, **ink** is applied to highlight the characters of the inscription.

Details Recording: Information about the **inscription's location** is noted on the back of the sheet for record-keeping.

Purpose: Allows precise replication of ancient texts for **analysis and preservation**. Aids in understanding **historical rulers** and **dynastic history** through corroboration with other sources.

Nambi Rayar Temple: Thirukurungudi, Tirunelveli district, Tamil Nadu.

Dravidian-style temple, part of the **Vaishnavite tradition**.

Lord Vishnu, worshipped as **Nambi Rayar**.

An important **Divya Desam**, one of the 108 Vishnu temples revered by the **Alvars**. Known for its **architectural grandeur** and **historical inscriptions**, including records of **land donations** for temple rituals.

Inscription describes the **gift of tax-free land** to the temple for the creation of a **flower garden** to supply flowers for temple rituals (**pujas**).

Inscription, written in **Tamil**, dates back to the **Vijayanagara period**, mentioning **land boundaries** during a king's reign.

Thirumalai Nambi Temple: Thirukurungudi, situated in the **Western Ghats** near Tirunelveli, Tamil Nadu.

Vaishnavite temple - Lord Vishnu, in the form of **Thirumalai Nambi**.

Set in a **picturesque hill** area, part of the **Pancha Nambi Kshetrams** (five sacred places dedicated to Lord Nambi).

Inscriptions reveal **historical donations** and local community involvement in temple management.

Aniliswarar Temple: Thirukurungudi, Tirunelveli district, Tamil Nadu.

Shaivite temple - Lord Shiva, worshipped as **Aniliswarar**.

Contains **Pandya period inscriptions** in **Vattezhuthu** script. Historical records mention donations like **sheep** for ghee to light perpetual lamps, reflecting **ritualistic practices** of the time.

Inscription is from the **Pandya period**, reflecting the **religious and social practices** of the time.

About Pandyas: Southern India, primarily **Tamil Nadu**.

From around **6th century BCE** to **14th century CE**.

Capital: **Madurai**.

Prominent Kings: **Nedunjeliyan**, **Sundara Pandya**.

Religion: **Shaivism** and **Vaishnavism** were prominent.

Contributions: Known for **temple architecture**, particularly **Meenakshi Temple**. Flourished in **trade** with Roman and Southeast Asian regions.

Decline: Overpowered by **Delhi Sultanate** in the 14th century.

About Vijayanagar: Founded in **1336 CE**, lasted until **1646 CE**.

Capital: **Hampi**.

Prominent Kings: **Krishnadevaraya**, **Harihara**, and **Bukkaraya**.

Religion: Patronized **Hinduism**, supported both **Shaivite** and **Vaishnavite** traditions.

Contributions: Known for **prosperity, literature, and temple architecture** (e.g., **Virupaksha Temple**). Prominent in **trade** and defense against Muslim invasions.

Decline: Weakened after the **Battle of Talikota (1565 CE)** against Deccan Sultanates.

Back on Govt's agenda: Study to trace roots of ancient Indian communities, this time using modern genomics

Sub :History

Sec: Ancient India

Context:

- The **Indian government** has launched a **scientific study** to **investigate the population history of South Asia** using **ancient and modern genomics**, addressing conflicting theories on the **origins of ancient Indian communities.**

About the study:

- Conducted by the *Anthropological Survey of India (AnSI)* under the **Ministry of Culture.**
- Titled **"Reconstruction of the Population History of South Asia using ancient and modern genomics".**
- Involves studying **300 ancient skeletal remains,** including **cranial** and **bone fragments,** collected from **key archaeological sites** in **India** and **Pakistan,** such as **Harappa, Mohenjo-Daro,** and **Lothal.**
- Collaboration with the *Birbal Sahni Institute of Palaeosciences (Lucknow),* under the **Department of Science & Technology.**
- **Key Sites Studied**:
  - Remains from sites like **Harappa, Mohenjo-Daro** (Pakistan), **Burzahom** (Jammu & Kashmir), **Nagarjunakonda** (Andhra Pradesh), **Maski** (Karnataka), **Ropar** (Punjab), and **Lothal** (Gujarat).
  - These remains were excavated between **1922** and **1958** by the **Archaeological Survey of India (ASI).**
- **Aims of the Study**:
  - Explore the **origins** of **ancient Indian communities** using **DNA** from skeletal remains.
  - Discover clues about **ancient diets, living conditions, disease prevalence, environmental adaptation,** and **migration patterns.**
  - Gain insights into interactions and **gene-sharing among ancient populations.**

o Provide clear conclusions on ancient population movements, including potential Aryan migration.

Historical Context:

- **19th-century scholars** proposed the *Aryan invasion theory*, suggesting a migration of **fair-skinned agrarian people** from **Central Asia** who played a significant role in shaping **Indian civilization** after the **Indus Valley period (2000-1,500 BC).**

- **Modern Indian archaeologists** argue that **Aryans were indigenous,** residing along the **Saraswati River,** and migrated after the river dried up.

- Recent excavations, such as the **4,000-year-old site** in **Sinauli (Uttar Pradesh),** have found evidence of **indigenous burials of warriors and chariots.**

- **Impact on History Narratives**:
  - o Recent findings cast doubts on the **Aryan migration theory,** emphasizing a continuous **5,000-year Indian civilization.**
  - o The study seeks to provide a more accurate narrative of India's ancient history.

Progress & Partnerships:

- The project started with an MoU between **AnSI** and the **Birbal Sahni Institute** in July 2023 and **aims** for completion by **December 2025.**

- **DNA extraction** from ancient remains is ongoing, with initial results showing continuity without significant genetic changes.

- **AnSI** has also partnered with **University College London** to further explore **genetic** and **cultural evolution** in **human populations.**

Who were Aryans?

- The term **'Aryan'** or **'Arya'** appears to be the **most ancient one** used for **Indo-Europeans.** The **Aryans** were **central Asian Steppe pastoralists** who arrived in **India** between roughly **2000 BCE and 1500 BCE** and brought **Indo-European languages to the subcontinent.**

- There, they came upon the **Indus or Harappan cities,** destroyed them, and drove survivors southward (where they became **'Dravidians'**), although some proposed that the **Aryans** arrived after the **decline of the Indus cities.**

- In any case, they swept across the Indus plains, composed the **Vedas** over several centuries, spread **Sanskrit** and their **caste system throughout India,** and established the **mighty Ganges civilization.**

- Earlier interpretations regarding the **Early Vedic society** are based on the **theory of Indo-Aryan migration from West Asia** into the **Indian subcontinent.** According to this historical interpretation, the **Aryans** came to India in several stages or waves.

- **Aryans and Vedas:** The composers of the **Rig Veda** described themselves as **Arya,** which can be understood as a cultural or ethnic term.

The **Indo-Aryans** were the speakers of a sub-group of the **Indo-Iranian branch** of the **Indo-European family of languages.**

What is the Aryan Invasion Theory?

- **Aryan migration theory (AMT)** was first proposed by **European scholars** in the **nineteenth century**, most notably **F Max Muller** and **linguist William Jones.** It was a convenient way to explain obvious similarities between **Sanskrit** and **Greek** or **Latin** since another branch of the **Aryans** was assumed to have **migrated towards Europe.**

- **Archaeologists** have made attempts to link various **post-Harappan cultures** to the **Aryans.** The **Painted Grey Ware,** which has been dated between **900 and 500 BCE**, has been repeatedly associated with **Aryan craftsmanship.**

- Following the **linguistic similarities** discovered between the **Rigveda** and the **Avesta,** archaeologists attempted to find similarities in **pottery forms, paintings on ceramics,** and **forms of copper objects,** among other things, between **post-Harappan** and **West Asian/Iranian Chalcolithic assemblages.**
  - o Such parallels were exaggerated to support the theory that the **Aryans** were a people who **migrated from West Asia** to the **Indian subcontinent.**
  - o As a result, literary and archaeological works were created to complement one another in order to validate the concept of migration.

- **Linguistic similarities** between the **Rigveda** and the **Avesta** are undeniable. However, such similarities do not imply a **large-scale migration of people** into the **Indian subcontinent.**

- **Secondly,** the similarities that have been found between **Chalcolithic artefacts of India** and those of **Western Asia** are only occasional. They also do not suggest large-scale migration of people.

- Although the **Rigveda** repeatedly mentions hostilities and wars between different groups, archaeology has not documented so-called **clashes** between **Aryan** and **non-Aryan communities and cultures.**

16th Century Copper plates discovered in Tiruvallur

Sub: History

Sec: Ancient History

Context:

- A set of **copper-plate inscriptions** dating back to the **16th Century CE** have been discovered at the **Sri Singeeswarar temple** at Mappedu village in Tiruvallur district of Tamil Nadu recently.
- The two leaves of the copper plates were strung together using a ring that had the seal of the **Vijayanagara Kingdom**.
- According to Archaeological Survey of India, the inscription was **written in Sanskrit** using the **Nandinagari script**. It was engraved in **1513** during the reign of King **Krishnadevaraya**.

About Vijayanagara Kingdom:

- The Vijayanagar Empire was founded in **1336** by **Harihara and Bukka**.
- Initially serving under the **Kakatiya rulers of Warangal**, they later declared their independence and established a new city on the south bank of the **Tungabhadra River**, naming it **Vijayanagar (city of victory).**
- The Vijayanagara Empire witnessed the reign of four dynasties: **Sangama, Saluva, Tuluva, and Aravidu.**
- The kingdom **reached its zenith under Krishna Deva Raya** during which it held military superiority over rivals like the Bahmani Sultanate, Golconda Sultanate, and the Gajapatis of Odisha.
- During the reign of **Rama Raya**, he was defeated at the **Battle of Talaikotta in 1565** by the combined forces of Bijapur, Ahmednagar, Golconda, and Bidar, marking the **decline** of the Vijayanagar Empire.
- The last ruler of Vijayanagar was **Sri Ranga III**.

Krishna Deva Raya (1509-1529):

- Krishnadevaraya of **Tuluva dynasty** was the most famous ruler of Vijayanagar. His rule was characterised by expansion and consolidation.
- He became the dominant ruler of the peninsula by defeating the **sultans of Bijapur, Golconda, the Bahmani Sultanate and the Gajapatis of Odisha**.
- Titles: **Andhra Bhoja, Mooru Rayara Ganda, and Kannada Rajya Rama Ramana**
- The Portuguese travellers **Domingo Paes and Duarte Barbosa** visited the Vijayanagara Empire during his reign.
- He Promoted Telugu literature and was a patron of poets like Allasani Peddana His era is called the **Golden Age of Telugu literature**.
- **The Ashtadiggajas** was a group of eight renowned poets in his court, who played a key role in enriching Telugu literature and arts.
- **Amuktamalyada** written by Krishnadevaraya is considered a classic in Telugu literature.
- Initially a follower of Shaivism, he later embraced Vaishnavism and constructed temples for both Shiva and Vishnu, exemplifying religious tolerance.

Nandinagari script:

- Nandinagari, a **variant of Nagari script**, is mostly confined **to the Karnataka region**.
- The Nandinagari script was used in South India between the 8th and 19th centuries for writing manuscripts and inscriptions.
- It is written from left to right.

How archaeologists unearthed ancient cities in Central Asia's mountains

Sub : History

Sec: Ancient India

Context:

- In **2015,** archaeologist Michael Frachetti learned from a local official about ancient ceramics near his excavation site in **southeastern Uzbekistan.** This led to the discovery of **Tugunbulak,** a vast **fortified city dating to a medieval empire.**
- Frachetti's team spent nearly a decade mapping **Tugunbulak** and **Tashbulak**, another high-altitude site in **Uzbekistan**.

Key Findings

- **Mountain Trade Routes:** The discoveries at these **high-altitude sites** (about 6,500 feet above sea level) challenge the traditional view that the **Silk Road trade routes** stayed in lowland areas. These mountain routes reveal a more intricate **Silk Road network.**

- **Centers of Industry:** Surrounded by **iron-rich Malguzar Mountains, Tugunbulak** and **Tashbulak** may have been **centres for weapons manufacturing.** Excavations have uncovered **pottery, coins,** and **jewellery**, suggesting a vibrant trade for weapons and other items.
- **Complexity of Nomadic and Urban Life:** The findings blur the lines between **nomadic and urban societies,** showing that medieval nomads also established substantial settlements.

The Role of the Silk Road:
- Initiated by **Chinese explorer Zhang Qian,** the **Silk Road** connected **East and West Asia** from the **2nd century B.C. to the 15th century A.D.**
- **Central Asian cities** like **Samarkand** and **Bukhara** were pivotal hubs, but the USSR's historical narrative largely overlooked contributions from medieval nomadic cultures. Sites like **Tashbulak** and **Tugunbulak** illustrate these cultures' urban influence.

Challenges in Exploring Tugunbulak:
- **Tugunbulak,** a **390-acre area,** was difficult to map due to its size and **Uzbekistan's strict drone regulations.** After negotiations, Frachetti's team obtained permission for limited drone use.
- Initial drone photography faced challenges with high winds and subpar image quality, and ground-penetrating radar was impractical for such a large site.

How Lidar Enhanced the Research:
- In **2022,** Frachetti returned with a **lidar-equipped drone. Lidar,** or **"light detection and ranging,"** measures distances using **laser pulses**, creating precise topographical maps.
- Over 22 flights, the team collected **421 million data points,** revealing structures like **walls, roads, and buildings.** Data analysis with a custom algorithm by computer scientist Tao Ju helped interpret these findings.
- While lidar provided critical insights, traditional excavation methods remain essential to fully understand these sites.

National Ayurveda Day
Sub : History

Sec: Ancient India

National Ayurveda Day is celebrated annually in India to promote the traditional Indian system of medicine known as Ayurveda. This day typically falls on **Dhanvantari Jayanti**, which is observed two days before Diwali. Dhanvantari, considered the god of medicine in Hindu mythology, is worshiped for health and healing.

Key Points:
- **Objective**: To increase awareness about the holistic benefits of Ayurveda, which emphasizes prevention and wellness through natural treatments, diet, and lifestyle.
- **History**: The Ministry of AYUSH initiated National Ayurveda Day in **2016** as part of efforts to preserve and promote traditional medicine systems.
- **Activities**: Various events are organized across India, including seminars, workshops, and health camps to educate the public on Ayurveda's principles.
- **Theme**: Each year focuses on a theme, such as Ayurveda's role in public health or managing modern lifestyle diseases.

The day serves as a reminder of Ayurveda's contributions to healthcare, emphasizing balance between mind, body, and spirit.

Who was Dhanvantari
- **Lord Dhanvantari** holds a significant role in Ayurveda's history, revered as the **physician of the Gods** and a skilled surgeon.
- In Hinduism, **worshipers seek his blessings for effective healing**.
- Legend has it that, **as the king of Kashi i.e. Divodasa,, Dhanvantari taught the science of Ayurveda to sages**, including the r**enowned surgeon Susruta.**
- Dhanvantari recasted **Brahma's Ayurveda into 8 divisions**i.e**shalya, shalakya, kayachikitsa, bhutavidya, kaumarabhrtya, agadatantra, rasayanatantra, vajikaranatantra** and began teaching within the **framework of pratyaksa (perception), agama (authoritative scripture), anumana (inference) and upamana (analogy).**
- He is also considered an **avatar of Vishnu**, and a well-known tale depicts him **emerging from the churning ocean with a bowl of nectar** during the quest for the elixir of life.
- In the context of Ayurveda, **physicians of the School of Atreya** were known to **refer surgical cases to practitioners from the School of Dhanvantari.**

What is the meaning of the name:
- The **term "dhanus"** is a **symbolic representation** indicating the **science of surgery, and Dhanvantari,** having **mastered it, is associated** with this knowledge.

- The word "**dhanvan**" is **linked to the concept of a desert,** as seen in **RigVeda [V.36.1], where** "**dhanvachara**" signifies **someone moving in a desert.**
- This aligns with a **Vedic mantra expressing Lord Vishnu** as akin to a **place in the desert where water is provided to travelers** (**dhanvanivaprapaasi**).
- Therefore, **Dhanvantari, as the incarnation of Lord Vishnu** holding a **pot of nectar, symbolizes a nourishing oasis in the desert of worldly existence.**

History of Ayurveda

Ayurveda, the science of life is one of the ancient and comprehensive systems of health care. The quest for good health and long life is probably as old as human existence. Four Vedas considered as oldest Indian literatures composed between 5000 and 1000 BC have information on treatment by plants and natural procedures. Reference of medicine and surgery are also found in Indian epics like Ramayana and Mahabharata. However, Ayurveda was established as a fully grown medical system from the period of Samhita (compendium) i.e., around 1000 BC. The compendia like **Caraka Samhita** and **Susruta Samhita** were written in a systematic manner with eight specialties during this period. The essential details of **Caraka Samhita** and **Susruta Samhita** were compiled and further updated in the treatises **Astanga Sahgraha and Astanga** Hrdaya authored by **Vrddha Vagbhata and Vagbhata** during 6 - 7 Century AD. Thus, the main three treatises called **Brhattrayi i.e., Caraka Samhita, Susruta** Samhita and **Astanga Sangraha** formed the basis for subsequent scholars to write texts.

Around 200 BC, medical students from different parts of the world used to come to the ancient **University of Takshashila** to learn Ayurveda. From 200 to 700 AD, University of Nalanda also attracted foreign medical students mainly from Japan, China etc. The Egyptians learnt about Ayurveda long before the invasion of Alexander in 400 BC through their sea-trade with India. Greeks and Romans came to know about it after their invasion. In the early part of the first millennium Ayurveda spread to the East through Buddhism and greatly influenced the Tibetan and Chinese system of medicine and herbology.

Around **800 A.D., Nagarjuna** has conducted extensive studies on the medicinal applications of various metals. Many exotic and indigenous drugs for new uses are found place in Ayurvedic literature. After 16th Century, there have been inclusions of diagnosis and treatment of new diseases based on modern medical science.

In **1827, the first Ayurveda** course was started in India at the **Government Sanskrit College, Calcutta.** By the beginning of 20th Century, many Ayurveda colleges were established in India under the patronage of provincial Rulers. Ayurveda gained more ground beginning in the 1970s, as a gradual recognition of the value of Ayurveda revived. Lots of academic work was done during the 20th century and many books were written and seminars and symposia were held.

Presently Ayurveda has well-regulated undergraduate, postgraduate and doctorate education in India. A commendable network of practitioners and manufacturers exists. Infrastructure development in private and public sectors has improved the outreach to the community in a commendable way.

Marathi among 5 languages accorded 'classical language' status

Sub: History

Sec: Art and Culture

Context:
- The **Union Cabinet** approved the recognition of *Marathi*, *Pali*, *Prakrit*, *Assamese*, and *Bengali* as **classical languages.**
- This decision reflects the government's effort to honor these languages as **custodians of India's cultural heritage.**

Significance:
- PM Narendra Modi emphasized **Marathi** as a **symbol of Indian pride,** stating that the recognition would encourage more people to learn the language.
- While these languages are primarily linked to states like *Maharashtra* (**Marathi**), *Bihar*, *Uttar Pradesh*, *Madhya Pradesh* (**Pali and Prakrit**), *West Bengal* (**Bengali**), and *Assam* (**Assamese**), the broader impact will extend nationally and internationally.

Background on Classical Language Status
- In **October 2004**, the Centre introduced the category of *classical languages* with **Tamil** as the **first.**
- The recognition of a **classical language** is based on **criteria** established by a **Linguistic Experts Committee.**
- **According to the committee,** the following revised benchmarks must be met for a language to be considered **"classical":**
  - **High antiquity** of (its) is early texts/recorded history over a period of **1500- 2000 years**.
  - A body of ancient literature/texts, which is considered a heritage by generations of speakers.
  - Knowledge texts, especially prose texts in addition to poetry, epigraphical and inscriptional evidence.
  - The Classical Languages and literature could be distinct from its current form or could be discontinuous with later forms of its offshoots.

- **Recognised Classical Languages are: Tamil (2004), Sanskrit (2005), Telugu(2008), Kannada (2008), Malayalam(2013)** and **Odia (2014).**

Benefits of Classical Language Status:
- Once a language is designated as **classical,** the **Ministry of Education** provides various benefits to promote it, including:
    - **Two major international awards annually** for scholars of eminence in the language.
    - Establishment of a **Centre of Excellence for Studies in the Classical Language.**
    - Requesting the **University Grants Commission (UGC)** to create **Professional Chairs** in **Central Universities** dedicated to the **classical language.**

Institutional Support for Classical Languages:
- The *Ministry of Education* has taken steps to promote these languages, such as:
    - Establishing **three central universities** in **2020** to promote *Sanskrit.*
    - The *Central Institute of Classical Tamil* facilitates translations of **ancient Tamil texts and offers courses.**
    - **Centres of Excellence for *Kannada, Telugu, Malayalam,*** and ***Odia*** were also set up to promote these **classical languages**.

Prakrit & Pali: All you need to know about the newly designated Classical Languages

Sub : History

Sec: Art and Culture

Context:
- Among the five languages recently granted Classical Language status are Pali and Prakrit, both derivatives of Sanskrit that were widely used in Ancient India.
- The other languages are Marathi, Bengali and Assamese.

Prakrits: the language of the people
- The term 'Prakrit' **derives from 'prakriti,' meaning 'source' or 'origin'.** Most scholars believe this refers to the Prakrits having evolved from Sanskrit.
- They were **much simpler than Sanskrit,** and thus the language used by the masses, as opposed to **Sanskrit being the language of the elites**.
- Most pre-Gupta inscriptions, including the **Ashokan edicts** (3rd Century CE), were composed in various forms of Prakrit.

No one Prakrit:
- There is **no one Prakrit language**. Rather, Prakrit generally refers to **a group of closely-related Indo-Aryan languages**, which may also have other names.
- The term Prakrit encompasses **various languages and dialects**. Some scholars define it to include all **Middle Indo-Aryan languages** that derived from Sanskrit.
- These languages eventually evolved into the modern languages we speak today, such as **Hindustani, Marathi, and Bengali**.

Some notable Prakrits include:
- **Magadhi:**
    - Official language of the Mauryan court and spoken by the people of Magadha.
    - Ashokan edicts were written in Magadhi.
    - Evolved into modern languages like Bengali, Assamese, Odia, and the Bihari languages (Bhojpuri, Magahi, and Maithili).
- **Ardhamagadhi:**
    - Variation of the Magadhi language prominently used by **Jain scholars.**
    - Most Prakrit courses today teach Ardhamagadhi.
- **Shauraseni:**
    - Used in North and Central India.
    - The speech of women and people from the lower classes in Sanskrit plays was often denoted in this Prakrit.
    - Evolved into Hindustani, Punjabi, and other languages of the Hindi group.

Pali: language of Buddhist canon
- As vernacular languages, Prakrits were chosen by heterodox religions like Jainism and Buddhism.

- Pali has traditionally been linked to Magadhi Prakrit, with the term 'pali' meaning **"lines or series,"** referring to it as the language of Buddhist texts.
- However, some modern scholars think that Pali is a **blend of several Prakrit languages**, including some western dialects, that were combined and partly influenced by Sanskrit.
- Pali is the language of the **Theravada Buddhist canon** and due to its significance to Buddhism, Pali is the **variant of Prakrit** that is most studied today.
- After Theravada Buddhism declined in India, Pali continued to exist as a religious language in Sri Lanka, Myanmar, Thailand, Laos, and Cambodia, where this branch of Buddhism thrived.

Pali canon:
- The Pali Canon refers to the standard collection of scriptures divided into three general baskets (Tripitakas) in the **Theravada Buddhist tradition**, written in the Pali language.
- **Vinaya Pitaka** (Discipline Basket): deals with **rules or discipline** of the Buddhist sangha.
- **Sutta Pitaka** (Sayings Basket): the largest basket comprising discourses and sermons of the Buddha himself, as well as some religious poetry.
- **Abhidhamma Pitaka**: the basket that further elaborates on **Buddhist philosophy**.

Charles Correa's designs were about people, climate

Sub: History

Sec: Art and Culture

Context:
- The **sixth Z-axis conference**, organized by the **Charles Correa Foundation (CCF)**, was titled **Conversations with Charles Correa: A critical review on six decades of practice,** and it reflected on his impressive 60-year career.

Z-axis conference:
- The Z-Axis Conference is a platform dedicated to discussions on **architecture, urban planning, and related fields**.
- It brings together professionals, scholars, and enthusiasts to explore innovative ideas and reflect on significant contributions in these areas.
- The documentary **Volume Zero**, shown at the conference highlighted Correa's dedication to prioritizing people and nature in his designs.
- The conference also marked the launch of his **biography titled Citizen Charles**, authored by architect **Mustan sir Dalvi**.

About Charles Correa:
- Charles Correa, an influential architect and urban planner, believed that architecture should be like sculpture, designed for people and infused with life.
- Some of Correa's famous projects include the **Gandhi Memorial Museum, Bharat Bhavan, Jawahar Kala Kendra, and Madhya Pradesh Vidhan Bhavan**, all of which promoted inclusivity and responded to climate challenges.
- Correa also understood the housing needs of lower-middle-class families and proposed **Navi Mumbai** to the government. After his proposal was accepted, he served as the **Chief Architect for the City** and Industrial Development Corporation of Maharashtra.

ICCR Hosts Conference Advocating Classical Language Status for Pali

Sub: History

Sec: Art and Culture

Why in News

The **Indian Council for Cultural Relations (ICCR)** organized a significant conference in **Colombo, Sri Lanka,** focused on advocating for the recognition of **Pali** as a **classical language in India.** This gathering brought together **Buddhist scholars and monks** from countries such as **Sri Lanka, Nepal, Myanmar, and Bangladesh**, highlighting **Pali's** cultural and religious importance in **Buddhist traditions.**

About Pali:

Pali is the canonical language of **Theravāda Buddhism,** containing essential **Buddhist scriptures** like the *Tripitaka.*

The **Pali Canon,** known as the *Tipitaka,* was **first orally transmitted** and **later written down in Sri Lanka** in the **1st century BCE.**

Pali is considered an **early Prakrit language,** closely related to the vernacular dialects spoken during the time of Buddha.

Pali's use declined in India after the 12th century, but it was revived by Buddhist scholars in **Sri Lanka, Myanmar, and Thailand.**

Pali is often called a "dead language" as it was mainly a **literary and liturgical language, not spoken as a native tongue.**

The spread of Pali through Buddhist texts helped promote Indian culture and spirituality in Southeast Asia.

Pali continued to be preserved and promoted by councils, especially the **Sixth Buddhist Council held in Myanmar in 1954–1956.**

Granting classical status to Pali would help conserve the language and recognize its contributions to **spiritual and cultural heritage**.

About Indian Council for Cultural Relations (ICCR):

The **Indian Council for Cultural Relations (ICCR)** is an **autonomous body under the Ministry of External Affairs, Government of India.**

Established in 1950 by **Maulana Abul Kalam Azad,** ICCR's mission is to promote Indian culture globally and foster cultural exchanges with other nations.

It is an **autonomous organisation of the Government of India**, involved in India's external cultural relations i.e., cultural diplomacy.

Its **objectives are:**

- to **actively participate** in the **formulation and implementation of policies and programmes** pertaining to **India's external cultural relations.**
- to **foster and strengthen cultural relations** and **mutual understanding** between India and other countries,
- to **promote cultural exchanges** with other countries and people, and to develop relations with nations.

It is **running 36 cultural centres** in **different countries** with the promotion of Indian culture and projecting India as a hub for higher education.

It **instituted several awards for foreign nationals** as a way to promote India's culture abroad:

- Distinguished Indologist Award
- World Sanskrit Award
- Distinguished Alumni Award – Citation and Plaque
- Gisela Bonn Award

Revival of the National Mission for Manuscripts: A New Initiative to Preserve India's Ancient Texts

Sub: History

Sec: Art and culture

Why in News

The **Union Ministry of Culture** recently announced plans to relaunch and revitalize the **National Mission for Manuscripts (NMM)** to enhance the preservation of India's ancient manuscripts. A proposal to establish an independent, autonomous body, likely named the **National Manuscripts Authority**, is under consideration. This decision underscores the government's commitment to conserving the rich heritage encapsulated in India's historic manuscripts.

National Mission for Manuscripts (NMM):

The **National Mission of Manuscripts (NMM)** was established to unearth and preserve India's vast wealth of manuscripts.

The **NMM was founded in 2003** under the **Indira Gandhi National Centre for the Arts (IGNCA), Ministry of Culture**, Government of India.

NMM has recorded metadata for approximately **52 lakh manuscripts** across the country.

Over **3 lakh titles** have been digitized, with about **one-third of these manuscripts uploaded online** for public access.

Over the past 21 years, NMM has undertaken preventive and curative conservation on nearly **9 crore manuscript folios**.

These manuscripts include a wide variety of themes, **languages, scripts, textures and aesthetics, illuminations, calligraphies, and illustrations.**

The chief mandate of the mission is to identify, collect, document, preserve and conserve the manuscripts from all over India and make it accessible to people.

Its motto is '**conserving the past for the future'**.

Formation of an Autonomous Body

The Ministry is considering converting the **NMM into an autonomous entity, the National Manuscripts Authority.**

Objective: To **streamline and strengthen the conservation and digitization efforts** by enabling independent operations under the **Ministry of Culture.**

Functions of the National Manuscripts Authority

Expanding the scope of **metadata compilation** to cover a **wider range of manuscripts** across various **Indian languages and regional scripts.**

Accelerating the pace of **digitization** to ensure a **substantial number of manuscripts** are preserved in **digital format and made accessible.**

Implementing **advanced preventive and curative measures** for **physical manuscripts** to maintain their structural integrity over time.

About Manuscripts:

A manuscript is a **handwritten composition** on **paper, bark, cloth, metal, palm leaf or any other material dating back at least seventy-five years** that has significant **scientific, historical or aesthetic value.**

Lithographs and printed volumes are not manuscripts.

Manuscripts are found in **hundreds of different languages and scripts.** Often, one language is written in a number of different scripts. For example, **Sanskrit is written in Oriya script, Grantha script, Devanagari script and many other scripts.**

Manuscripts are distinct from historical records such as **epigraphs on rocks, firmans, revenue records** which provide direct information on events or processes in history. **Manuscripts have knowledge content.**

Manuscripts in India

India's manuscripts have for centuries captured the imagination of the world.

As early as the **seventh century Chinese traveller Hiuen Tsang took back hundreds of manuscripts from India.**

Later in the late eighteenth century, the **Nawab of Awadh gifted a superb illuminated manuscript of the Padshahnama to King George III of England.** Today, it is considered one of the finest pieces in the Royal Collection.

National Museum is a treasure for Manuscripts and ancient written records.

The replica of **Girnar Rock Edict** is placed in the prime place to view and know the creative genius of **Indian scribes.**

The **major, minor rock edicts and pillar edicts of Ashoka** found across India are in the languages of **Bramhi, Prakrit, Greek and Kharoshti,** which are earliest written documents.

Declaring Delhi's Jama Masjid protected monument will have substantial impact, ASI tells HC

Sub: History

Sec: Art and Culture

Context:

- The **Archaeological Survey of India (ASI)** informed the **Delhi High Court** that declaring **Jama Masjid** a **"protected monument"** would have significant implications, though no actions have been taken toward this designation.
- If the **monument** were protected, specific regulations and restrictions would apply in its vicinity.
- **ASI** noted that, while **Jama Masjid** is under the **Delhi Waqf Board's protection,** it still conducts conservation and preservation work there.
- **Court's Observations**:
  - A Bench comprising **Justice Prathiba M. Singh** and **Justice Amit Sharma** expressed hesitation to designate the Jama Masjid as a protected monument, in line with ASI's stance.
- **Background on the Petition**:
  - The petitions, filed in **2014**, urge authorities to declare the **Jama Masjid** a **protected monument** and address encroachments around it.
  - They question why Jama Masjid remains outside ASI's management despite its historic significance.
- **Government Counsel's Input**:
  - The Centre's representative clarified that **Jama Masjid** functions as a **"live monument,"** where regular prayers are held, imposing unique restrictions.
  - Since it is **not a centrally protected monument, Jama Masjid does not currently fall under ASI's administrative jurisdiction**.

What are Centrally Protected Monuments?

- The **Ancient Monuments and Archaeological Sites and Remains Act (AMASR Act) 1958** regulates the **preservation of monuments and archaeological sites of national importance.**
- The Act protects monuments and sites that are **more than 100 years old,** including temples, cemeteries, inscriptions, tombs, forts, palaces, step-wells, rock-cut caves, and even objects like cannons and mile pillars that may be of historical significance.
- The **Archaeological Survey of India (ASI)**, which is under the aegis of the Union Ministry of Culture, functions under this Act.

Jama Masjid:

- The **Jama Masjid** (also called **Masjid-i Jahān-Numā**) was **built** between **1650-1656** during the reign of **Mughal Emperor Shah Jahan,** who also built the **Taj Mahal.**
- The mosque's construction was supervised by **Saadullah Khan, Shah Jahan's prime minister**.

Architecture and Design:

- Built using **red sandstone** and **white marble**
- Three large gates, four towers, and two 40m-high minarets
- The courtyard can accommodate approximately 25,000 worshippers
- The mosque is elevated on a platform accessed by a flight of **39 steps**
- Features **three large domes** with alternating black and white stripes
- The main prayer hall contains intricate calligraphy and decorative elements

Historical Significance:

- Served as the **principal mosque of the Mughal emperors** until **1857**
- Represents the pinnacle of **Mughal architectural achievement**
- Located in **Old Delhi.** At the time of its construction, it was the largest mosque in the Indian subcontinent.

Location and Setting:

- Situated in the heart of Old Delhi (Shahjahanabad)
- Overlooks the **Red Fort** and faces west towards **Mecca**
- Central location in what was once the capital of Mughal India

What is ASI?

- It was founded in **1861** by a **British Army engineer Alexander Cunnigham** who is also known as the **'Father of Indian Archaeology'.**
- It engages in archaeological research and conservation, and protection and preservation of ancient monuments and archaeological sites in the country.
- **ASI** regulates all archaeological activities conducted in the country through the provisions of the **Ancient Monuments and Archaeological Sites and Remains Act (AMASR Act), 1958.**
- It also regulates the **Antiquities and Art Treasure Act, of 1972.**
- **ASI** has more than **3,693 protected monuments and archaeological sites of National Importance** that it protects and preserves.

Modi lauds RSS for its 100-year journey

Sub: History

Sec: Modern India

Context:

- As the **Rashtriya Swayamsevak Sangh (RSS)** celebrated its centenary year on Saturday, Prime Minister Narendra Modi congratulated the organization.

About RSS:

- The Rashtriya Swayamsevak Sangh (RSS) was founded on **September 27, 1925,** by **K.B. Hedgewar in Nagpur**, India.
- The RSS aims to promote **the concept of Hindutva**, which emphasizes the **cultural and national identity** of Hindus in India.
- The RSS is considered the ideological parent of the Bharatiya Janata Party (BJP), influencing Indian politics.

Functioning:

- It operates as a **volunteer organization** with a **hierarchical structure**, including various wings and affiliates focused on social, cultural, and educational activities.
- Over the years, the RSS has expanded its reach, with thousands of **branches (shakhas)** across India and a growing presence among the Indian diaspora.
- The RSS conducts **training camps, community service projects, and cultural programs**, promoting discipline and patriotism among its members.

Criticism:

- The RSS came under scrutiny following the assassination of Mahatma Gandhi by Nathuram Godse in 1948. The organization was **banned temporarily** but was later allowed to operate again.

- The RSS has faced criticism for its perceived role in promoting Hindu nationalism and for **allegations of fostering communal tensions**, though it advocates for national integration.

History of ban:

- **1948**: RSS was banned following Gandhi's assassination, but the ban was lifted in 1949 after it pledged allegiance to the Constitution.
- **1966**: Government employees were prohibited from joining the RSS, which was reiterated in 1970 and 1980.
- **1975-1977**: The organization was banned during emergency, which was ban lifted in 1977.
- **1992**: The RSS was banned after the Babri Masjid demolition, which was lifted in 1993 when a commission found the ban unjustified.

Controversy Surrounds Dropped Couplet from Jyotiba Phule Memorial

Sub : Schemes

Sec: Health

Why in News

A political controversy erupted after a key line referring to the word 'Shudra' from **Jyotiba Phule's seminal work** *Shetkaryacha Asud* was omitted from an inscription at the newly inaugurated **Phule memorial in Nasik.**

Memorial: Inaugurated by **CM Eknath Shinde,** the memorial features an **18-foot bronze statue of Jyotiba and Savitribai Phule.**

About Jyotiba Phule:

- **Jyotirao Govindrao Phule (11 April 1827 – 28 November 1890)** was an Indian social activist, thinker, anti-caste social reformer and writer **from Maharashtra.**
- His work extended to many fields, including **eradication of untouchability and the caste system** and for his efforts in educating women and oppressed caste people.
- He and his wife, **Savitribai Phule,** were pioneers of women's education in India.
- **Phule started his first school for girls in 1848 in Pune** at TatyasahebBhide's residence or Bhidewada. He, along with his followers, formed the **Satyashodhak Samaj** (Society of Truth Seekers) to attain equal rights for people from lower castes.
- **Phule's akhandas were organically linked to the abhangs of Marathi Varkari saint Tukaram**.
- Among his notable published works are:
  I. **Tritiya Ratna, 1855**
  II. **Brahmananche Kasab, 1869**
  III. **Powada 1869**
  IV. **Manav Mahammand (Muhammad) (Abhang)**
  V. **Gulamgiri, 1873**
  VI. **Shetkarayacha Aasud (Cultivator's Whipcord), 1881**
  VII. Phule was **influenced by Thomas Paine's book titled The Rights of Man** and believed that the only solution to combat the social evils was the enlightenment of women and members of the lower castes.
- **It is believed by many that it was Phule who first used the term 'Dalit'** for the depiction of oppressed masses often placed outside the 'varna system'.
- He was bestowed with honorific **Mahātmā title** by Maharashtrian social activist **Vithalrao Krishnaji Vandekar in 1888.**

About Savitribai Phule:

- **Savitribai Phule (3 January 1831 – 10 March 1897)** was an Indian social reformer, educationalist, and poet **from Maharashtra.**
- She is regarded as the **first female teacher of India.** Along with her husband, JyotiraoPhule, she played an important and vital role in improving women's rights in India.
- **She is regarded as the mother of Indian feminism.**
- **Savitribai and her husband founded one of the first Indian girls' school in Pune,** at Bhidewada in 1848. It was the country's first school for women started by Indians.
- She worked to **abolish the discrimination and unfair treatment** of people based on caste and gender.
- In the 1850s, the Phule couple initiated two educational trusts—**the Native Female School, Pune and The Society for Promoting the Education of Mahars, Mangs and Etceteras**—which came to have many schools under them.
- She published Kavya Phule in 1854 and Bavan Kashi Subodh Ratnakar in 1892. In her **poem, Go, Get Education,** she urges the oppressed communities to get an education and break free from the chains of oppression.
- In **1852, Savitribai started the MahilaSeva Mandal** to raise awareness about women's rights.

- She simultaneously campaigned against child marriage, while supporting widow remarriage

IR

India, ISA to contribute $35 million to global solar facility

Sub : IR

Sec: Int Conventions

Context:

- The ISA announced a capital **contribution of $35 million to the Global Solar Facility (GSF)** during the **sixth assembly of the ISA, hosted by India.**
- The ISA has signed memoranda of understanding with several organizations, including the Multi-Lateral Investment Guarantee Fund (MIGA) and the West African Development Bank (BOAD), to facilitate investments through the GSF in Africa.

About Global Solar Facility:

- The Global Solar Facility (GSF) is an **initiative of the International solar Alliance (ISA)** aimed at promoting solar energy investments, particularly in **underserved markets of Africa**.
- After focusing on Africa, the GSF plans to expand to regions like **Asia**, **Latin America**, and the **Middle East**.
- The facility has two financial components:
  - Solar Payment Guarantee Fund
  - Solar Insurance Fund
- It aims to support off-grid solar projects, rooftop solar installations, and solar applications for productive use.
- GSF is expected to provide private investors with the **confidence to take up projects in Africa** and to enable $10 billion in investments.

Targets:

- The GSF aims to **raise $100 million**.
- This initiative is expected to enhance **clean energy access for 35-40 million African households by 2030**, benefiting approximately 200 million people.

Importance of Solar Energy in Africa:

- Despite having significant solar potential, Africa currently **accounts for only 1.3% of the world's installed solar capacity**.
- With nearly 600 million people lacking electricity, the region is a prime candidate for decentralized solar energy projects.

Global parliamentarians rally behind WHO pandemic agreement in Berlin

Sub: IR

Sec: Int Conventions

Context:

- Parliamentarians from around the world gathered in **Berlin, Germany** to support the **World Health Organization's (WHO) Pandemic Agreement** by signing a landmark global statement at the **UNITE Global Summit.**

Global Parliamentary Statement emphasised four core commitments:

1. **Equity**: Ensuring equitable access to pandemic-related health tools, especially for low-resourced nations.
2. **Global Solidarity**: Strengthening international cooperation for resilient health systems.
3. **Legislative Action**: Advocating for the ratification and implementation of the WHO Pandemic Agreement in national legislatures.
4. **Combating Misinformation**: Promoting evidence-based health information to counter harmful misinformation.

Impact of the Statement:

- Expected to foster **global parliamentary action** and **international cooperation.**
- Demonstrates a shared understanding that pandemics transcend borders and require unified efforts to protect global public health.

About UNITE Global Summit:

- It is the **world's leading Forum** for forging partnerships between **parliamentarians and leaders** from the **global health community**.
- Leading parliamentarians from across the world will gather with experts from civil society, affected communities, international organizations and academia to discuss the most pressing issues in **Global Health** and set the political agenda for the year(s) to come.
- This event, held in partnership with the **World Health Summit,** marks a crucial step in improving **global pandemic preparedness, response, and equitable healthcare access.**
- The **UNITE Global Summit 2024's agenda** will be divided into **four main pillars** which cover relevant global health topics of the hour:
  - o Human Rights & Equitable Access to Health
  - o Global Health Architecture & Security
  - o Strengthening of Healthcare Systems
  - o Sustainable Financing for Health

WHO Pandemic Agreement:

- **Purpose**: Aimed at addressing gaps exposed by the **COVID-19 pandemic** and other outbreaks (e.g., mpox), focusing on global cooperation in pandemic prevention, preparedness, and response.
- **Key Focus**:
  - o Ensuring equitable access to vaccines, treatments, and medical supplies
  - o Pathogen Surveillance
  - o Build stronger healthcare workforces and systems worldwide
  - o Encourages the transfer of technology to aid in producing vaccines and tests
  - o Plans to tackle the growing issue of antimicrobial resistance

Russia's Nuclear Arsenal: A Strategic Show of Force Amid Ukraine Conflict

Sub : IR

Sec: Int conventions

Why in News

In 2023, **Russian President Vladimir Putin** repeatedly emphasized Russia's nuclear capabilities in an attempt to deter Western support for Ukraine. This comes amidst **rising tensions between Russia and NATO, as Moscow warns against NATO's involvement in the ongoing war in Ukraine.** Putin's recent actions include **revising Russia's nuclear doctrine,** conducting military exercises with nuclear capabilities, and threatening to resume nuclear tests.

Russia's Nuclear Arsenal as a Strategic Deterrent

President Putin has underscored Russia's possession of the world's largest nuclear arsenal to prevent further Western involvement in Ukraine.

Russia announced the production of ground-based intermediate-range missiles, previously banned under the **1987 US-Soviet treaty.**

Russia's nuclear doctrine was revised to lower the threshold for using its nuclear arsenal.

Russia's Strategic Nuclear Weapons

Largest Nuclear Stockpile: Russia holds **5,580 deployed and non-deployed nuclear warheads,** compared to the US's 5,044, making up about 88% of the world's nuclear weapons.

Modernization of Nuclear Forces: Upgraded Soviet-era nuclear components with modernized land-based intercontinental ballistic missiles (ICBMs), submarines, and bombers.

Deployment of mobile **Yars ICBMs** and the newer **Sarmat ICBMs.**

Expansion of **Borei-class submarines** armed with **Bulava missiles**.

Recommissioned **Tu-160 supersonic bombers** for nuclear strikes.

Russia's Non-Strategic (Tactical) Nuclear Weapons

Iskander Missiles: Ground-launched missiles with a range of 500 km, capable of carrying nuclear or conventional warheads.

Kinzhal Hypersonic Missiles: Air-launched missiles that can be nuclear-armed and have been used conventionally against Ukraine.

Revised Nuclear Doctrine

Putin revised Russia's nuclear doctrine in response to perceived threats from NATO, stating that **any conventional attack on Russia by a non-nuclear country backed by a nuclear power could trigger a nuclear response.**

The doctrine now includes nuclear retaliation for a massive air attack, adding ambiguity to deter Western forces.

Russia's Arms Control and New START Treaty

The **New START Treaty** (2010) between **Russia and the US,** which limits nuclear warheads, is set to expire in 2026. In February 2023, Putin suspended Russia's participation but pledged to continue abiding by its terms.

New START Treaty:

The **New Strategic Arms Reduction Treaty (New START)** pact **limits the number of deployed nuclear warheads, missiles and bombers** and is due to expire in 2021 unless renewed.

The treaty limits the US and Russia to a **maximum of 1,550 deployed nuclear warheads and 700 deployed missiles and bombers,** well below Cold War caps.

It was **signed in 2010** by former US President Barack Obama and then-Russian President Dmitry Medvedev.

It **entered into force** on 5th **February, 2011.**

It is one of the key controls on the superpower deployment of nuclear weapons.

Its **duration was for ten years that is till 2021**, but it was **extended by five more years till 2026.**

Nuclear Testing and Future Weapons Development

Resumption of Nuclear Testing: Russia indicated it could resume nuclear tests if the US does so, ending a global ban in place since the collapse of the USSR. The Arctic test range at **Novaya Zemlya** is reportedly prepared for testing.

Development of New Weapons:

Avangard Hypersonic Glide Vehicle: Travels at 27 times the speed of sound, capable of evading missile defenses.

Poseidon Underwater Drone: Designed to create a radioactive tsunami near enemy coastlines.

Burevestnik Cruise Missile: An atomic-powered missile facing technological and safety challenges, with accidents during testing.

About NATO

Formed in **1949** with the signing of the Washington Treaty, NATO is a **security alliance of 31 countries from North America and Europe.**

In April 2023, Finland joined the alliance as its 31st member.

NATO's fundamental goal is to **safeguard the Allies' freedom and security by political and military means.**

It is a system of **collective defence** where independent member states agree for mutual defence in case of any attack by external party.

Article 5 of the Washington Treaty states that an attack against one Ally is an attack against all. This article forms the core of the Alliance, a promise of collective defense.

Headquarter – Brussels, Belgium.

Shadow Fleets, Sanctions, and Flags of Convenience: Understanding Global Shipping Complexities

Sub : IR

Sec: Int conventions

Why in News

The concept of **"shadow fleets"** has recently garnered attention due to the involvement of tanker ships carrying **Russian crude oil,** especially in the context of the **Russia-Ukraine conflict.** India, among other nations, has been accused of hosting shadow fleets that are allegedly helping in transporting and 'laundering' Russian crude oil, bypassing international sanctions.

What is Shadow Fleets?

The term **"shadow fleet"** refers to tanker ships that discreetly transport goods, particularly crude oil, from **sanctioned nations like Russia,** avoiding detection and regulations.

What are Flags of Convenience (FoC)?

Flags of Convenience refer to **ships registered in countries other than those where their actual owners reside.** This practice obscures the real ownership and origin of cargo, often used by large corporations to dodge sanctions and **evade legal scrutiny.**

About Flags Hopping: To avoid sanctions, ships often **change their flags by registering in different countries. Panama and Liberia,** for instance, are popular FoCs, known for **tax avoidance and lenient regulations.**

Large corporations establish multiple **shell companies,** each owning just one or two ships. **This creates a web of ownership** that makes it difficult to track the true owners of vessels and their cargo.

Sanctions and Global Shipping Industry

When countries like the **U.S. impose sanctions,** they target companies, individuals, and entities that violate these sanctions. **Assets are frozen, and legal action is taken.** For example, **U.S. sanctions limit Russia's oil sales** to a cap of $60 per barrel, while market prices hover above this, ensuring that Russia cannot make significant profits to fund its war in Ukraine.

Role of Insurance in Sanctions

Ships are often insured through **Protection and Indemnity (P&I) clubs,** which cover risks such as loss of life and damage to property. Sanctioned entities may lose their insurance cover, but shipowners find ways around it, such as shifting management to a third-party country that is compliant with insurance regulations.

About Protection and Indemnity (P&I) Clubs:

P&I clubs are **mutual insurance groups** providing coverage to **shipowners, charterers, and operators.**

They cover **third-party liabilities** such as damage to cargo, injury or loss of life, and environmental pollution.

Shipowners pool risks by becoming members of these clubs, sharing **potential liabilities.**

Many of these clubs are **managed from London,** with strong links to global maritime regulations and sanctions enforcement. **Ships involved in violating sanctions risk losing P&I club coverage,** affecting their operations globally.

Macron hosts Francophone leaders in bid to boost clout

Sub: IR

Sec: Int groupings

Context:

- French President Emmanuel Macron is preparing to welcome leaders from many French-speaking countries for the **Francophonie summit**.

About Francophonie summit:

- The summit aims to strengthen France's influence among French-speaking nations, particularly in Africa.
- For the first time in 33 years, the summit will be hosted by France.

L'Organisation Internationale de la Francophonie:

- Founded in 1970, the L'Organisation Internationale de la Francophonie (the International Organization of La Francophonie) is an institution organising relations between countries that use the French language.
- The organization aims to promote the French language and foster cooperation among its **88 member states, which include 54 full members, 7 associate members, and 27 observers**.
- These goals are outlined in the **Charter of La Francophonie**, adopted at the **Hanoi Summit in 1997**.

Francophone Countries:

- Nations where **French is a significant language**, either as an official language or widely spoken by the population.
- The **majority of Francophone countries are in Africa**, including nations like Democratic Republic of the Congo, Ivory Coast, and Senegal.
- It includes countries like **Canda** and Pacific Island Nations such as **Vanuatu and New Caledonia**.

Diminishing French influence:

- France's influence in Africa has declined significantly due to a series of coups: Mali in 2021, Burkina Faso in 2022, and Niger in 2023.
- These events led to the **replacement of governments that were friendly to France with military juntas** that have started to align with Russia.
- At the same time, the ongoing crisis in **Lebanon, a former French colony** facing daily Israeli attacks and now a ground invasion, highlights France's diminished influence in West Asia.

OPEC+ could cushion Iran oil shock but not a broader disruption

Sub: IR

Sec: Int groupings

Context:

- Iran fired missiles at Israel in response to Israeli attacks, leading to threats of further retaliation by Israel.
- Security experts have said **Israel could target Iran's oil refining sites** and the **Kharg Island oil port,** which handles around **90% of the country's overall crude exports.**
- OPEC and the US can help ease oil prices in case there is disruption in supply due to a full-blown conflict between Israel and Iran.

OPEC's spare capacity:

- OPEC can **compensate for a complete loss of Iranian oil supply** if Israel strikes Iranian oil production facilities.
- OPEC+ has been **reducing oil production in recent years to support prices** due to **weak global demand**. As a result, the group has millions of barrels of spare capacity available.
- However, much of it is in the Gulf region, which is vulnerable if the conflict escalates.
- If tensions escalate, Iran's proxies might target oil facilities in other Gulf countries, notably Saudi Arabia.

Iran's oil production:
- Iran is a member of the OPEC and produces about **2 million barrels per day** (bpd), contributing **3% to global output**.
- Exports have risen to approximately 1.7 million bpd despite US sanctions, with China being the main buyer.

Impact on Oil Prices:
- Oil prices have remained **stable ($70-90 per barrel)** in recent years, despite global conflicts such as Russia-Ukraine war and the conflict in West Asia.
- Increased US production has helped stabilize the market, reducing fears of significant supply shocks.
- The **US produces 13% of global crude** whereas **OPEC accounts for 25% global crude production** and around **40% by OPEC+.**

About OPEC:
- The **Organization of the Petroleum Exporting Countries (OPEC)** was founded in Baghdad, Iraq in 1960 by five countries: **Iran, Iraq, Kuwait, Saudi Arabia and Venezuela**.
- As of 2020, OPEC has a total of 13 member countries: Iran, Iraq, Kuwait, Saudi Arabia, Venezuela, **UAE, Algeria, Libya, Nigeria, Gabon, Equatorial Guinea and Republic of Congo**.
- Angola left the grouping in 2023.
- It is headquartered in **Vienna, Austria.**
- In addition to its members, OPEC collaborates with non-member countries like Russia and Kazakhstan in a group known as OPEC+ to manage oil production collectively.

Objectives of OPEC:
- To coordinate and unify petroleum policies among member states.
- To secure fair and stable prices for petroleum producers.
- To ensure a regular supply of oil to consumers.
- To provide a fair return on capital for those investing in the petroleum industry.

OPEC + countries:
- OPEC+ is the alliance of crude oil producers that manages oil production and supply.
- OPEC plus countries include **Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, Russia, South Sudan and Sudan.**

ASEAN summit calls for an end to violence in Myanmar
Sub: IR
Sec: Int Grouping
Context:
- The ASEAN summit held in Vientiane addressed **ongoing violence and instability in Myanmar** following the military coup in February 2021.
- Leaders urged an immediate cessation of violence and highlighted the importance of dialogue among all parties involved.

Five-Point Consensus:
- ASEAN reaffirmed its commitment to the five-point consensus established in April 2021.
- The junta had previously agreed to a five-point plan with ASEAN to restore peace but has largely ignored it and continued military action.
    - Immediate cessation of violence.
    - Dialogue among stakeholders.
    - Appointment of a special ASEAN envoy.
    - Humanitarian aid.
    - A timeline for the implementation of these measures.

About ASEAN:

- ASEAN is a regional organization established in 1967 to promote political and social stability among the **Asia-Pacific's post-colonial states**.
- Established with the signing of the **Bangkok Declaration**.
- Secretariat: Jakarta
- Members: Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei, Vietnam, Laos, Myanmar, Cambodia.

Army to commemorate 62 years of the Battle of Walong with China

Sub : IR

Sec: Neighbouring countries

Context:

- To mark the **62nd anniversary** of the iconic **Battle of Walong** during the 1962 war with China, the Army is planning a month-long series of commemorative events.
- The events include white water rafting, motor cycle rallies, bicycle rallies, battlefield treks, adventure treks and a half marathon.
- In addition to various activities, the newly renovated **Walong War Memorial, Shaurya Sthal at Lama Spur**, and several key infrastructure projects in border areas will be inaugurated.

About Battle of Walong:

- The Battle of Walong took place during the **1962 Sino-Indian War**, marking a significant episode where the Indian Army defended against the advancing **People's Liberation Army (PLA)** of China.
- Indian forces under the **11 Infantry Brigade**, with Kumaon, Sikh, Gorkha, and Dogra regiments successfully halted the Chinese advance for **27 days**, forcing the PLA to commit additional resources.
- The Indian soldiers operated with **limited ammunition and resources**, earning praise for their bravery
- The battle unfolded in the difficult terrain of **Kibithu, Namti Tri Junction (famously known as Tiger's Mouth), Walong** and its adjoining areas in Arunachal Pradesh.
- 14th November is observed as **Walong Day.**

Walong:

- Walong is located on the eastern-most part of Arunachal Pradesh.
- The place is situated on banks of the Lohit River.

India-China Border Patrol Agreement: What It Means, Why It Is Important

Sub : IR

Sec: India neighbouring countries

Context:

- In a notable development, **India and China** have established a **new patrolling arrangement** along the **Line of Actual Control (LAC)** four years after the Galwan Valley clash.
- The arrangement allows Indian and Chinese soldiers to resume patrols as they did prior to the May 2020 conflict, aiming to reduce tensions between the two nations.

Context of the Galwan Clash:

- The Galwan Valley clash on June 15, 2020, was a significant escalation along the LAC, resulting in the first deadly confrontation in the region since 1975.
- **Border infrastructure developments and differing perceptions of the LAC** had triggered the clash.

Significance of the new Agreement:

- **De-escalation:** The agreement marks a significant step towards de-escalation in a region heavily fortified by both countries as it is expected to reduce skirmishes.
- **Stabilisation:** This arrangement is expected to stabilize conditions along the LAC, particularly at friction points like the Depsang Plains and Demchok. Enhanced stability may facilitate broader negotiations on long-standing boundary issues.
- **Confidence-Building:** Resuming patrolling under pre-2020 terms serve as a confidence-building measure, reflecting a mutual commitment to return to a previously acceptable status quo.

Political Implications:

- The agreement could lead to **enhanced diplomatic interactions** at various **international forums** and improve bilateral relations outside military contexts.
- For India, this means better management of border infrastructure development without the looming threat of conflict.

- For China, it represents a strategic decision to stabilize its border with India amid various global tensions.

About LAC:

- The **Line of Actual Control (LAC)** is the demarcation that separates Indian-controlled territory from Chinese-controlled territory.
- It is not agreed upon by the two countries, and is **neither delineated on a map nor demarcated on the ground**.
- India considers the LAC to be 3,488 km long, while the Chinese consider it to be only around 2,000 km.
- It is divided into **three sectors**: the **eastern sector which spans Arunachal Pradesh and Sikkim, the middle sector in Uttarakhand and Himachal Pradesh and the western sector in Ladakh.**
- The alignment of the LAC in the eastern sector is along the **1914 McMahon Line**.
- The western sector witnesses the highest transgressions between the two sides.

Other friction points along the LAC:

- **Demchok:** Demchok is divided by the LAC, with India controlling the western part and China claiming both the eastern and western regions. The dispute centres on historical treaties and the precise alignment of the LAC, along the **Charding Nullah**.
    - o The Charding Nullah is a stream traditionally known as the **Lhari stream** and called **Demchok River by China**.
- **Pangong Lake:** Pangong Lake is a contested area where approximately 50% is under Chinese control, 40% is in Ladakh, and 10% remains disputed.
- **Hot Springs:** The Hot Springs area near Gogra Post is **strategically important** for India in enhancing its surveillance capabilities over the LAC. India's control over this region enhances its defence posture, providing vantage points for monitoring movements in Aksai Chin.
- **Depsang Plains:** The Depsang Plains are crucial for India due to their strategic access to the **Daulat Beg Oldie (DBO) airstrip and the Darbuk-Shyok-DBO road**. Maintaining control over Depsang prevents potential threats from Chinese forces to these **key logistics lines**.

BRICS nations should strengthen financial integration, says PM

Sub: IR

Sec: Int Grouping

Context:

During the **16th BRICS summit** held in Kazan, Russia, Prime Minister Narendra Modi emphasized India's support for greater financial integration among member countries.

He underscored the importance of trade in local currencies and the facilitation of smooth cross-border payments to enhance economic cooperation within BRICS.

16th BRICS Summit:

- The 16th BRICS summit was attended for the **first time** by the leaderships of new member countries **Egypt, UAE, Saudi Arabia, Ethiopia, and Iran.**
- The summit concluded with the **Kazan Declaration**, which articulated BRICS's collective stance on pressing global issues, including conflicts in Gaza and Ukraine.
- **BRICS Cross-Border Payments Initiative (BCBPI):**
- The **BRICS Cross-Border Payments Initiative (BCBPI)** aims to enhance financial cooperation and facilitate smoother cross-border transactions among BRICS member countries.

Objectives:

- Enhance **collaboration in financial transactions and trade**, fostering economic ties within BRICS.
- The BCBPI focuses on promoting trade among BRICS nations by **enabling transactions in local currencies**, thus reducing reliance on major global currencies like the U.S. dollar and promoting **economic sovereignty**.
- It also aims to create a more resilient economic framework that can **withstand external shocks**, such as sanctions or global economic fluctuations.
- It is also expected to **lower costs associated with currency conversion** and international payments.

Features of BCBPI:

- The initiative is **non-binding**, allowing countries to adopt it based on their needs.
- Promotes the **integration of existing payment systems** across BRICS nations, like India's **Unified Payments System (UPI).**
- Potential expansion to include more countries, enhancing the global reach

Retro bonds return from the '80s to speed up debt reworks, but at a cost

Sub : IR

Sec : Int grouping

Context:

- The recent wave of **sovereign debt defaults** has revived interest in complex securities known as **State Contingent Debt Instruments (SCDIs)**.

About State Contingent Debt Instruments (SCDIs):

- State Contingent Debt Instruments (SCDIs) are financial instruments issued by a government that have **repayment obligations linked to specific economic conditions or performance**
- These instruments emerged in the 1980s during the Latin American debt crisis.
- They are designed to **expedite debt restructurings** by linking bond payouts to a country's economic or fiscal performance.
- SCDIs often incorporate economic growth metrics, such as GDP, but can also be tied to various revenue streams.
- Countries such as **Ukraine and Sri Lanka** have utilized SCDIs to navigate challenging debt negotiations, offering investors potential **returns tied to the country's economic recovery**.

Benefits of SCDIs:

- **Crisis management**: Provides a buffer during economic crises, reducing the immediate fiscal pressure. SCDIs can facilitate smoother negotiations between cash-strapped nations and bondholders.
- **Incentivizes growth**: Encourages better economic performance, as governments have a vested interest in achieving economic targets.
- **Investor appeal**: Unlike traditional sovereign bonds, which offer fixed interest payments, SCDIs may yield higher returns if a country's economy outperforms expectations. This characteristic can entice investors, potentially aiding in the resolution of debt crises.

Challenges and Concerns:

- **Higher borrowing costs**: Reliance on SCDIs could increase future borrowing costs, as some investors may hesitate to purchase bonds that carry uncertain payout structures.
- A **2022 report by the Bank for International Settlements**, reveals that **governments often face higher premiums** on these instruments, ranging from 4.24% to 12.5% above typical liquidity and default premiums.

Case Studies: Zambia and Ukraine

- Zambia's recent restructuring showcases the importance of SCDIs in providing relief while promoting economic development. The Zambian government linked repayment obligations to its **debt-carrying capacity**, with **assessments guided by the IMF** rather than government data to enhance credibility.
- Ukraine's swift debt restructuring during wartime illustrates the practical application of SCDIs. By offering **GDP-linked bonds**, Ukraine incentivized investors to exchange defaulted bonds for newer instruments, which could yield **greater returns if the economy rebounds**.

BRICS Unveils Symbolic Banknote and Pushes for Local Currency Trade Amid Dollar Debate

Sub : IR

Sec: Int grouping

- **Symbolic BRICS Banknote Unveiled:**
  - At the recent BRICS summit held in **Kazan, Russia**, a symbolic banknote featuring the flags of **Brazil, Russia, India, China, and South Africa** was unveiled.
  - The banknote signifies the **collective ambition** of BRICS nations to **explore alternatives to the US dollar in cross-border transactions** and reduce dependence on Western financial structures.
- **Putin's Stance on Dollarization:**
  - **Russian President** emphasized that the BRICS nations are **not rejecting the US dollar** outright but are preparing alternatives if needed.
  - He highlighted that the **use of the dollar as a political weapon undermines global trust** in the currency.
- **Endorsement of Local Currency Settlements:**
  - During the summit, BRICS nations formally endorsed the **settlement of cross-border payments in local currencies**.

- o The **Kazan Declaration** issued on **October 23, 2024 -** This initiative is part of the broader **BRICS Cross-Border Payments Initiative**, promoting **voluntary, non-binding** use of local currencies.
- o India has already implemented measures to allow trade settlements in **rupees with Russia and the UAE** and is in talks with other nations like **Indonesia**.
- **Challenges and Transition to a Fairer Economic System:**
  - o While endorsing local currencies marks a bold move, BRICS faces challenges in transitioning to a **more independent economic system**.
  - o Putin remarked that the speed of transition depends on moving away from **Western-dominated financial platforms**.
  - o The longer BRICS operates within the current system, the more **turbulence** it may encounter.
- **Focus on Local Currency Settlements and Financial Infrastructure:**
  - o Despite the symbolic unveiling of a potential common currency, the immediate focus of BRICS remains on **enhancing local currency settlements** and **building financial infrastructure**.
  - o The bloc continues to **challenge the status quo of global finance** by seeking alternatives to dollar hegemony without directly opposing it, aiming for a **fairer and more resilient economic system**.

World Bank mulls 27 of 30 ideas on MDBs by G20 Independent Group

Sub: IR

Sec: Int org

Context:

- Union Finance Minister Nirmala Sitharaman praised the World Bank for considering 27 of the 30 **recommendations from the G20 Independent Expert Group** aimed at strengthening multilateral development banks (MDBs).

Independent Expert Group (IEG):

- Appointed under the 2023 Indian G20 Presidency.
- Its primary focus is on **strengthening multilateral development banks** (MDBs).
- The group recommended a **triple agenda** of reforms for multilateral development banks (MDBs) aimed at **tripling sustainable lending levels by 2030**.
  - o Eliminate extreme poverty.
  - o Boost shared prosperity.
  - o Contribute to global public goods.

What are Multilateral Development Banks:

- Multilateral Development Banks (MDBs) are international financial institutions created by multiple countries to provide financial and technical assistance for development projects in developing countries.
- MDBs include the World Bank Group, the Asian Development Bank, the African Development Bank, European Bank for Reconstruction and Development (EBRD) etc.

About World Bank:

- World Bank Group is a **specialised agency of the United Nations**, established in 1944.
- It is headquartered in Washington DC.
- It consists of five development institutions:
  - o International Bank for Reconstruction and Development (IBRD)
  - o International Development Association (IDA)
  - o International Finance Corporation (IFC)
  - o Multilateral Guarantee Agency (MIGA)
  - o International Centre for the Settlement of Investment Disputes (ICSID)
- **India is not a member of the ICSID** because it claims that the ICSID's functioning and structure are biased towards the developed countries.
- To join the World Bank Group, a country must first become a member of the IMF.
- It provides loans, guarantees, advisory services, and risk management products to middle-income and creditworthy low-income countries.

India makes pledge of $300 million for WHO programme

Sub :IR

Sec: Int Org

India's contribution:

- India has pledged over $300 million for the WHO's core program from 2025 to 2028. So far, WHO has received contribution pledges for over $2.2 billion towards a $7.1 billion funding gap.

- The largest share of $250 million will be spent on the **Centre of Excellence for Traditional Medicine.**

- India is the **sixth largest contributor** of core funding to the World Health Organization (WHO). India has committed the largest amount of funds so far in southeast Asia.

- The funding aims to save at least **40 million lives** over four years through various initiatives including **increased vaccine delivery** to priority countries and support to 55 countries in **training and employing** 2 million **health workers**.

WHO's funding:

The WHO relies on two primary types of funding: assessed contributions and voluntary contributions.

- **Assessed contributions:** These are mandatory payments made by member states, calculated based on the country's wealth and population. They support the core functions of WHO.

- **Voluntary contributions:** These are funds provided by member states, international organizations, and private sector entities. They often fund specific programs and initiatives.

Classification of Voluntary Contributions:

- These funds are categorized based on the flexibility WHO has in their allocation.

- **Core Voluntary Contributions (CVC):** Core Voluntary Contributions are fully unconditional, giving WHO complete discretion on fund usage.

- **Thematic and Strategic Engagement Funds:** These funds are partially flexible, allowing some discretion while meeting contributors' reporting and accountability requirements.

- **Specified Voluntary Contributions:** These contributions are tightly earmarked for specific programmatic areas and must be spent within a designated timeframe. Specified voluntary contributions made up **87% of all voluntary contributions** in 2022-2023.

Who are THE UN peacekeepers at Lebanon's border with Israel?

Sub: IR

Sec: Int Org

Context:

- India expressed its concern regarding the deteriorating security situation in parts of West Asia, particularly following an incident in which two members of the **United Nations peacekeeping mission in Lebanon, known as UNIFIL**, were injured.

- An Israeli tank fire hit an observation tower at the force's headquarters in Naqoura, Lebanon.

- Earlier, Israel had warned UNIFIL to relocate from Lebanese positions near where it said Hezbollah fighters had launched rockets into northern Israel. UN forces rejected the request.

United Nations Interim Force in Lebanon (UNIFIL):

- The United Nations Interim Force in Lebanon (UNIFIL) was established in 1978 and is currently composed of over 10,000 civilian and military personnel from 50 countries.

- Its primary purpose is to **prevent violations along the 121-km border between Lebanon and Israel**, known as the **Blue Line**.

- The mission is largely **observational**, though its mandate was expanded in 2006 to include reporting of any violations to the UN Security Council.

- A UN resolution passed in 2006 expanded UNIFIL's mandate to include ensuring that its area of operations is not used for any hostile activities.

- The group is charged by the UN with keeping out of the area any weapons or fighters.

- United States and Israel have argued that the peacekeepers have been largely ineffective at preventing Hezbollah from stockpiling and firing rockets from the territory they patrol.

UN Peacekeeping Mission:

- UN peacekeeping refers to the deployment of international personnel by the United Nations to help **maintain or restore peace** in conflict areas.

- It is a joint effort between the Department of Peace Operations and the Department of Operational Support. **Every peacekeeping mission is authorized by the Security Council.**

- The financial resources of UN Peacekeeping operations are the collective responsibility of UN Member States. According to UN Charter every Member State is legally obligated to pay their respective share for peacekeeping.

Composition:
- UN peacekeepers (**often referred to as Blue Berets or Blue Helmets because of their light blue berets or helmets)** can include soldiers, police officers, and civilian personnel.
- Peacekeeping forces are contributed by member states on a voluntary basis.
- Civilian staff of peace operations are international civil servants, recruited and deployed by the UN Secretariat.

Features:
- United Nations Peacekeeping helps countries torn by conflict create conditions for lasting peace.
- UN Peacekeeping is guided by **three basic principles**:
  - Consent of the parties.
  - Impartiality
  - Non-use of force except in self-defence and defence of the mandate.
- UN peacekeeping is a unique global partnership. It brings together the General Assembly, the Security Council, the Secretariat, troop and police contributors and the host governments in a combined effort to maintain international peace and security.

India and UN Peacekeeping:
- India is among the highest contributors of troops to the **UNPKF**, and has lost 179 soldiers in the past **six decades,** the highest fatality suffered by any country among **"blue helmets",** and has been demanding a greater say in the decision making on **U.N. peacekeeping missions**.

Israeli tanks ram gate of UN facility in Lebanon
Sub :IR

Sec: Int org

Context:
- The **Israel Defence Forces (IDF)** tanks destroyed the main gate of a UN peacekeeping facility in Ramyah, southern Lebanon, marking the fourth consecutive day of attacks on UN peacekeepers.
- United Nations Interim Force in Lebanon (UNIFIL) is a peacekeeping mission in south Lebanon that was established by the UN Security Council in 1978.
- UNIFIL condemned the IDF's actions as a blatant violation of international law and **Security Council Resolution 1701**, which mandates respect for the freedom of movement of UN peacekeepers.

Israel's demand:
- Israeli Prime Minister Benjamin Netanyahu urged UN Secretary-General Guterres to **withdraw UNIFIL forces from Hezbollah strongholds**, claiming their presence endangers peacekeepers and Israeli soldiers.

Security Council Resolution 1701:
- Adopted on August 11, 2006, UN Security Council Resolution 1701 aimed to **resolve the conflict between Israel and Hezbollah** that erupted in July 2006.
- It called for an immediate **cessation of hostilities** between Israel and Hezbollah, facilitating a stable and lasting peace.
- The resolution **expanded the UNIFIL**, increasing its troop presence and enhancing its mandate to monitor the ceasefire and support the Lebanese Armed Forces.
- The resolution called **for unhindered access for humanitarian assistance** to affected populations in Lebanon.
- It also mandates respect for the **security and freedom of movement** of UN personnel and humanitarian workers.

India and UNIFIL:
- UNIFIL comprises over 10,000 peacekeepers from 50 countries, with **India being the third-largest contributor**, supplying 903 soldiers. However, the Indian Battalion does not have a presence in Ramyah.
- A **joint statement from 40 troop-contributing countries**, including India to UNIFIL condemned the attacks on peacekeepers and emphasized the need for respect towards UNIFIL's mission and the safety of its personnel.

The world needs blue helmets who act as blue helmets
Sub: IR

Sec: Int Org

Context:

- The role of the United Nations (UN) in global peacekeeping and its failures in certain conflicts.

UN's stand on peacekeeping:
- **The UN has two relevant chapters:**
  - **Chapter VI**: Commitment to peaceful settlement of disputes.
  - **Chapter VII**: Allows armed force with Security Council authorization in cases of aggression.
  - **Chapter VIII**: Prescribes regional arrangements for enforcing peace.

UN Peacekeeping: Hits and Misses
- **Successes**: The **UN** has established **peace** in areas like **Cambodia, Mozambique, Sierra Leone, Angola, Timor Leste, Liberia** and **Kosovo.**
- **Failures**: In **Rwanda (1994)** and **Bosnia (1995)**, the **UN** failed to protect vulnerable populations, particularly civilians.
- **Improvement**: Later missions, such as in **Sierra Leone, Darfur,** and **South Sudan,** focused more on protecting civilians.

Current Conflicts: Ukraine and West Asia
- The **UN** has been criticized for its lack of action in the conflicts involving **Russia-Ukraine** and **Israel-Palestine.**
- Despite having over **100,000 peacekeepers** ready for deployment, the **UN** has failed to take decisive action to protect civilians in these regions.

UN Security Council and the Veto Power:
- The **veto power** of the **P5** (permanent members of the UN Security Council) often obstructs peacekeeping efforts.
- **Example:** During the **Rwandan genocide,** the **veto system** allowed inaction, leading to massive civilian deaths.
- **Proposed Reforms**:
  - Expanding the **Permanent Membership** of the **Security Council** to include countries like **India** and **South Africa.**
  - **Limiting the use of veto power** by requiring a majority decision among the expanded **permanent members (P7).**

Blue Helmets:
- **UN peacekeepers** serve as an **international force** working to **maintain peace and security** in **conflict zones.** The **blue helmet** and **insignia** were **first adopted** in **1947** and have become a **globally recognized symbol** of **UN peacekeeping operations.**
- The **first UN peacekeeping mission** was **established** in **May 1948.**
- **India** is **one of the largest troop contributors** with approximately **275,000 troops** to various peacekeeping missions, and almost **5900 personnel** are serving in **12 UN missions.**

Key aspects of UN peacekeeping forces include:
1. **Mandate and Mission**
- Monitor ceasefires
- Protect civilians
- Support peace agreements
- Assist in stabilization and state-building efforts
2. **Composition**
- Military, police and civilian personnel
- Contributed voluntarily by UN member states
- Currently around 90,000 personnel serving worldwide
3. **Core Principles**
- Consent of parties
- Impartiality
- Non-use of force except in self-defense and defense of the mandate

WHO activates Global Health Emergency Corps for the first time over mpox outbreak
Sub : IR
Sec: Int org
Context:

- The **World Health Organization (WHO)** has, for the first time, activated the **Global Health Emergency Corps (GHEC)**, in response to a significant **mpox outbreak** affecting multiple regions, particularly in **Africa.**
- This mobilization highlights an urgent global effort to control **mpox,** formerly known as **monkeypox.**

Mpox:

- Caused by the **MPXV virus** and spreads primarily through close contact.
- **Symptoms**: Fever, headache, back pain, fatigue, swollen lymph nodes, and a distinctive pox-like rash lasting 2-3 weeks.
- **Incubation Period**: Symptoms typically appear within 21 days of exposure.
- **Current Situation**: Africa has reported **over 15,600 cases** and **537 deaths** this year, with cases identified in **18 African countries** and the **clade 1b strain** also detected in other regions, including India, Sweden, and Thailand.

Global Health Emergency Corps (GHEC):

- The **Global Health Emergency Corps (GHEC),** founded in **2023** by the **World Health Organisation (WHO),** to address the gaps identified during the **COVID-19 pandemic**, represents **WHO's commitment to a unified, rapid, and efficient global health emergency response**.
- **Purpose and Structure:**
    o Created to build a strong, diverse workforce ready to respond to health emergencies
    o Consists of trained health professionals from various fields
    o Designed to provide quick deployment capabilities during crises
- **Main Functions:**
    o Emergency response deployment
    o Capacity building in countries
    o Technical expertise during health crises
    o Support for disease outbreak management
    o Coordination of international health responses
- **Key Actions by GHEC:**
    o **Support to Affected Countries**: Focusing on the **Democratic Republic of the Congo (DRC)** and other nations with high mpox prevalence.
    o **Workforce Deployment**: Mobilized **56 experts** to eight countries, enhancing local response capacities.
    o **Core Strategies**: Case detection, contact tracing, targeted vaccination, clinical and home care, infection prevention, community engagement, and logistical support.

Recent WHO Initiatives:

- **PHEIC Declarations**: **WHO** classified **mpox** as a **Public Health Emergency of International Concern (PHEIC)** in **2022** and reaffirmed this on **August 14, 2024**, in response to recent outbreaks.
- **Assessments and Preparedness**: Pharmaceutical manufacturers have been asked to assess their readiness to provide diagnostics, while **GHEC** has identified **22 critical areas** for response improvements in partnership with the International Association of National Public Health Institutes.

New Israeli laws bar UNRWA from operating on its soil

Sub : IR

Sec: Int org

Context:

- Israel recently passed two significant laws that pose a threat to the operations of the **United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA).**
- These laws could hinder the agency's ability to provide essential aid to people in Gaza.

Key Provisions of the Laws:

- The first law prohibits UNRWA from **conducting any activities or providing services within Israeli territory**. This move is seen as a direct attempt to limit the agency's operational capabilities.
- The second law would **cut Israel's diplomatic relations with UNRWA**, effectively isolating the agency and undermining its efforts to assist Palestinian refugees.

Implications of the law:

- With the ban on UNRWA, the agency's ability to provide humanitarian assistance will be severely restricted.
- The laws may strain Israel's relationships with its international allies, particularly those advocating for Palestinian rights and humanitarian assistance.

- The laws could make peace efforts more difficult.

About UNRWA:

- The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) is a United Nations agency established by the General Assembly in 1949 to **provide aid to Palestinians** who were **displaced during the 1948 Arab-Israeli war**.
- The UN agency operates in Gaza and the Israeli-occupied West Bank, as well as Lebanon, Syria, and Jordan, countries where the refugees took shelter after their expulsion.
- UNRWA was originally headquartered in Beirut but was moved to Vienna in 1978.
- Though it was established as a **temporary body**, in the absence of a solution to the Palestine refugee problem, the General Assembly has repeatedly renewed UNRWA's mandate, most recently extending it until **30 June 2026**.

Little Prespa Lake on Albanian-Greek border slowly dying

Sub : IR

Sec: Mapping

Context:

- Plants have sprouted up as the waters of Little Prespa Lake recede, indicating that the lake is slowly dying.

Little Prespa Lake:

- Situated on the **Albanian-Greek border.**
- The majority of the lake sits in Greek territory, with just its southern tip crossing into Albania.
- It is also known as Small Lake Prespa and is the **smaller of the two Prespa Lakes**.
- The larger Great Prespa Lake is situated to its north.

Current condition:

- Formerly a crystal-clear lake vital for local fishing communities, the lake has transformed into a marshy area, with **430 of the 450 hectares having turned into swamps** or dried out.

Contributing Factors:

- Environmental decline began in the 1970s due to **diversion of Devoll River** to irrigate fields around the nearby Albanian city of Korca.
- **Climate Change:** Rising temperatures and increasingly mild winters with reduced snowfall and precipitation has negatively impacted water levels.

Russia and China conducts joint naval patrol in the Pacific

Sub: IR

Sec: Msc

Context:

- **Russian and Chinese naval vessels** recently conducted a **joint patrol in the northeast Pacific** The patrol follows a series of joint military exercises between the two countries.
- Both countries are deepening their collaboration to counter Western military influence, with plans for China to participate in Russia's upcoming "**Ocean-2024" strategic exercise**.

Geopolitical Context:

- The move comes amid escalating **tensions with NATO**, which has labelled China as an **"enabler" of Russia's actions** in Ukraine.

Deepening China – Russia ties:

- Both nations are seeking to **counterbalance western influence** in global affairs.
- Joint participation in **international forums** (e.g., BRICS, Shanghai Cooperation Organization).
- **Growing trade relations**, including energy partnerships (oil and gas exports), with China being Russia's largest trading partner.
- Cooperation in **technology and infrastructure development** through initiatives like the Belt and Road Initiative.
- **Increased military exercises** with a focus on **anti-submarine warfare** and enhanced operational capabilities.

About Ocean 2014 exercise:

- Ocean 2024 is a military exercise conducted by Russia, focusing on enhancing naval capabilities and strategic readiness.
- It involves **various branches of the Russian armed forces**, showcasing advanced maritime tactics and coordination.

- Includes **live-fire exercises, anti-submarine warfare, amphibious landings**, and other tactical operations.
- China is expected to participate this year.

Germany extends temporary control on all land borders to 'limit migration'
Sub: IR
Sec: Places in news
Context:
- **Germany**'s introduction of **temporary border controls** with its **nine neighbouring countries** has sparked a mix of political reactions and concerns.

Details:
- **Extension of Border Controls**:
  - Previously, **Germany** had controls with **Poland, Czech Republic, Austria**, and **Switzerland.**
  - From **September 16, 2024,** these controls were expanded to include **France, Belgium, Luxembourg, the Netherlands,** and **Denmark.**
  - These controls are **aimed** at **limiting irregular migration** and enhancing internal security, according to the **German Interior Ministry.**
  - These controls will remain in effect until at least **March 2025**, with ongoing debates about their effectiveness and legal standing.
- **Security Concerns:**
  - Interior Minister Nancy Faeser highlighted threats from **Islamist terrorism** and **cross-border crime** as motivations for the measure.
  - These controls will be in place for **six months**, with a possibility of extension up to **three years** under **Schengen Area regulations.**

Political Context:
- Immigration has been a central political issue in **Germany** since **2015-16,** when over **a million Syrian refugees** were accepted.
- The **Dublin Regulation** holds that the **first EU countryan asylum seeker enters is responsible for processing their application,** but **Germany** argues the system is flawed.
- **Racial profiling** concerns are also being raised, with fears that random border checks could disproportionately target certain ethnic groups.
- **Rise of Extremism and Asylum Processing**:
  - The combination of extremist threats and migration policies complicates the situation.
  - While **asylum applications have dropped in Germany,** bureaucratic challenges remain. **First-time asylum applications decreased by 19% in the first half of 2024**.

The Immigration Crisis in Europe:
- The crisis peaked in **2015** when **over 1 million migrants and refugees** entered **Europe**, mainly fleeing conflicts in **Syria, Afghanistan, and Iraq.** While numbers have decreased since then, the issue remains a critical challenge for European countries.

Key Policies and Agreements:
- **Dublin Regulation**: This EU law determines which member state is responsible for examining an asylum application. Generally, it's the country where the asylum seeker first entered the EU.
- **EU-Turkey Deal (2016)**: An agreement to stem the flow of irregular migrants from Turkey to Greece. Turkey agreed to accept the return of migrants in exchange for financial aid and political concessions.
- **European Agenda on Migration (2015)**: A comprehensive plan to improve migration management, including measures to reduce incentives for irregular migration, save lives at sea, and reform the asylum system.

Recent Developments and Acts
- **UK-Rwanda Migration and Economic Development Partnership (2022)**
  - Announced in **April 2022** by the **UK government** as part of its strategy to deter **illegal entry and break people-smuggling networks.**
  - **Key features:**
    - Asylum seekers who arrive in the **UK** through unauthorized routes may be relocated to **Rwanda** for processing and potential resettlement.
    - **Rwanda** agrees to process these claims and, if successful, to grant asylum and support integration.

- The **UK** provides funding to Rwanda for processing and integration costs.
- **New Pact on Migration and Asylum (2020):** Proposed by the **European Commission** to overhaul the **EU's asylum system.** Key features include:
  - Faster border procedures for asylum screening
  - Fair sharing of responsibility among member states
  - Increased focus on returns for those not eligible for protection
- **Frontex Scrutiny Working Group (2021):** Established by the **European Parliament** to investigate allegations of **human rights violations by Frontex.**

How Israel took the war to the 'axis of resistance', triggering Iran's attack

Sub : IR

Sec: Places in news

Context:
- Iran fired a salvo of ballistic missiles at Israel in retaliation for Israel's campaign against Iran's Hezbollah allies in Lebanon.

Turn of events:

December 2023:
- Israel kills Sayyed Razi Mousavi, a senior IRGC (Islamic Revolutionary Guard Corps) general, in Damascus.
- Iran retaliates with a missile strike towards what it called a Mossad base in Erbil, Iraq.

April 1, 2024:
- Israel bombs Iranian embassy complex in Damascus.
- Brig. Gen. Mohammed Reza Zahedi and other officers killed.
- Iran sees a violation of its sovereignty.

April 14, 2024:
- Iran launches direct attack on Israel with over 300 drones and missiles.
- Israel's response to the April 14 attack is described as meek.

July 30, 2024:
- Israel hit three of its enemies, Iran, Hezbollah and Hamas, within 24 hours.
- Israel kills Fuad Shukr (Hezbollah) and Ismail Haniyeh (Hamas) in simultaneous strikes.
- Iran vows retaliation but holds back to facilitate Gaza peace talks. There was a shift in Iran's approach from **conservative to moderate due to leadership change**.
- Hezbollah, on the other hand, fired some 300 short-range rockets into Israel.

Different approaches:
- **Hezbollah:** After the rocket attack, Hezbollah indicates completion of retaliatory strikes, signalling a desire to avoid escalation. Hezbollah prefers a limited conflict rather than a full-scale war.
- **Iran:** Iran aims for a unified axis (including Hezbollah) to confront Israel more aggressively.

Escalation of conflict:
- Backed by the U.S., Israel is prepared for escalation in the conflict.
- When Israel sensed reluctance from its rivals, it decided to go with full force.
- Israel has been preparing for a potential war with Hezbollah since 2006.
- It started with pagers and walkie talkies, targeting Hezbollah's communication system.
- Then, Israel launched waves of massive air strikes aimed at senior Hezbollah commanders, including Hassan Nasrallah. This was followed by ground invasion of Lebanon.
- Israel's bottom-up approach was successful in weakening the most powerful non-state actor in the region and a major constituent of the axis of resistance.

Iran's options:
- **Retaliation:** If Iran retaliates, it risks provoking an even stronger Israeli response, potentially escalating to an **all-out regional war**.
- **Inaction:** Continued Israeli attacks could further weaken Iran and the axis as seen in the past.
- Both retaliation and inaction presented unfavourable outcomes for Iran.
- Pushed to a corner and faced with tough choices, Iran decided to launch its second direct attack on Israel.

Axis of Resistance:

- The Axis of Resistance is an informal **Iranian-led political and military coalition** in West Asia.
- The group describe themselves as the **axis of resistance to Israel and U.S. influence in the Middle East** includes Iran **Hamas, Hezbollah**, the Syrian government, the **Houthis of Yemen** and various **Shiite armed groups in Syria and Iraq**.
- Iran fostered the groups over decades to enable them to carry out attacks on Israel as well as other countries, such as Saudi Arabia, that Iran has sometimes viewed as enemies.

Congo rebel group gets $3,00,000 monthly from seized mine

Sub : IR

Sec: Places in news

Context:

- An **armed rebel group, M23**, generates approximately $300,000 monthly from mining control in eastern Congo, according to **UN mission in Congo**.
- M23 seized the **Rubaya mining** area in April, which has **significant deposits of tantalum, a key mineral for electronics**.

Tantalum:

- Tantalum is a rare metal extracted from coltan.
- Tantalum is used to manufacture **tantalum capacitors** which are used for mobile phones, personal computers, automotive electronics, and cameras.
- Rubaya in **Eastern Congo** contributes over **15% of the world's tantalum supply**.

About Coltan:

- Coltan is short for **columbite–tantalites** and known industrially as **tantalite**.
- It is a dull black metallic ore from which the elements **niobium and tantalum** are extracted.
- The niobium-dominant mineral in coltan is columbite, and the tantalum-dominant mineral is tantalite.
- Predominantly found in the Democratic **Republic of the Congo (DRC), Colombia, Rwanda, Australia, Brazil, China, Ethiopia, Mozambique, and Kenya**.
- Tantalum is also produced in Thailand and Malaysia as a **by-product of tin mining and smelting**.

Blood Minerals:

- **Blood minerals** refer to natural resources, particularly certain minerals and metals, that are mined in conflict zones and are often associated with **human rights abuses, exploitation, and violence.**
- The term is similar to **blood diamonds,** which are diamonds mined in war zones and sold to finance armed conflict.
- Tantalum has been identified as a "blood mineral" by the Congolese government, which questioned companies like Apple about their supply chain practices.
- The conflict in eastern Congo is one of the world's worst humanitarian crises, with over 120 armed groups vying for power. Violence has displaced approximately 6 million people in the region.

About M23:

- M23, or the **March 23 Movement**, is a rebel military group mainly made up of **ethnic Tutsis** that broke away from the Congolese army just over a decade ago.

Amid challenges, China marks 75 years of CPC rule

Sub : IR

Sec: Places in news

Context:

- China marked the 75th year of Communist Party rule, with minimal festivities, mainly a flag-raising ceremony at Tiananmen Square as economic challenges and security threats linger.
- Celebrations also took place in **Hong Kong and Macao**, emphasizing China's reclamation of these territories in the late 1990s.

Communist rule in China:

- The Communist Party of China (CPC) was founded in 1921.
- The Communists, led by Mao Zedong, **seized power in 1949** during a civil war with the Nationalists, known as the KMT.

- The KMT, led by Chiang Kai-shek, relocated their political, economic, and military power to Taiwan, which is now a self-governing democracy.

Political Structure:
- China is a **one-party state**, with the CPC controlling all aspects of governance.
- Political dissent and opposition are not tolerated, leading to human rights concerns.
- State control over media, education, and civil society is used to reinforce party ideology.

Economy:
- Economic reforms started in the late 1970s under Deng Xiaoping.
- These changes shifted China to a **"socialist market economy"** that encouraged foreign investment and private businesses, which resulted in quick economic growth.
- China has become the world's second-largest economy, driven by manufacturing and exports.

Expansionist policy:
- **Belt and Road Initiative (BRI):** The BRI aims to enhance trade and infrastructure development across Asia and beyond, which some view as a means for China to expand its influence and secure strategic territories.
- China claims a large portion of the **South China Sea**.
- China considers **Taiwan a breakaway province** and has expressed intentions to reunify it with the mainland.
- China's military has significantly modernized, focusing on capabilities to assert its claims in disputed regions, including naval power for operations in the South China Sea.

Challenges:
- China is facing issues such as economic slowdown, **aging population**, security threats from neighbouring countries, environmental issues due to rapid industrialization etc.

Economic issues:
- After decades of rapid growth, China is facing an economic slowdown.
- Chinese economy has struggled to regain momentum after the COVID-19 pandemic, with a prolonged **property slump** affecting construction and consumer goods sales.
- **Trade tensions**, especially with the U.S is affecting China's export-driven economy.
- Recently government announced measures to boost the economy including **lower interest rates and reduced mortgage down payment requirements**.

Geopolitical Tensions:
- China's territorial ambitions have led to increased tensions with neighbouring countries and responses from global powers, particularly the United States.
- China is facing **growing frictions with neighbours** including Japan, South Korea and the Philippines over territorial claims and their close relationships with the United States.
- Ongoing disputes in the South China Sea and territorial claims against Japan
- China insists on **annexing Taiwan**, potentially by force while US is supporting Taiwan in defending itself.
- China's **military expansion**, including the launch of a nuclear-capable ballistic missile into the Pacific, raises concerns about potential conflict.

UK-Mauritius treaty on Chagos Archipelago, Diego Garcia: What it means, why it matters for India

Sub: IR

Sec: Places in news

Context:
- **The UK** announced that it would cede **sovereignty** of the **Chagos Islands** to **Mauritius**. This settlement resolves a long-standing sovereignty dispute over **Britain's last African overseas territory**, while maintaining the **Diego Garcia military base** jointly operated by **the UK and US**.

Historical Background:
- **Chagos Archipelago:** Comprising **58 islands,** the **Chagos Archipelago** lies about **500 km south of the Maldives** in the **Indian Ocean.**
- The islands were **uninhabited until the late 18th century** when the **French** brought **enslaved Africans** and **Indians** to work in **coconut plantations.**
- After **France ceded the islands to Britain in 1814**, **Chagos** was attached to **Mauritius** for administrative purposes.

- When **Mauritius** gained independence in **1968**, **Chagos remained under British control**, with **Britain** offering **Mauritius** a grant of **£3 million** for the **"detachment"** of the islands.

Strategic Importance:
- **The UK** retained sovereignty over Chagos due to its **strategic military importance**.
- In **1966**, **Britain** and **the US** signed a defense agreement, and **Diego Garcia**, the largest island in the **Chagos Archipelago**, became a **major military base** by **1986**.
- The **BIOT (British Indian Ocean Territory)** administration expelled about 2,000 civilians from **Diego Garcia**, central to the sovereignty dispute.
- **Diego Garcia** has been used for critical **US military operations,** including in the **Gulf War**, the **wars in Iraq and Afghanistan**, and monitoring the **Malacca Strait**, a crucial trade route vital to **China**.

Sovereignty Dispute:
- **Mauritius** has long claimed that the **UK** illegally occupies **Chagos** and has raised the issue at the **UN and ICJ**.
- In **2017**, the **UN General Assembly** referred the issue to the **International Court of Justice (ICJ)**, which ruled in **2019** that the **UK** should **"unconditionally withdraw"** from the **Chagos Archipelago.**
- The **UK-Mauritius agreement** resolves this, with the **UK** ceding claims over the islands except **Diego Garcia**, which will remain a military base for **99 years**.

Implications of the Agreement:
- **Mauritius** is now free to implement resettlement on the **Chagos Islands**, except for **Diego Garcia.**
- **The UK** will create a **trust fund** for the displaced **Chagossians**.
- The agreement helps avoid Mauritius seeking alternative alliances, such as with **China**, which is increasingly assertive in the **Indian Ocean**.

India's Role:
- As a former British colony, **India** has supported **Mauritius' claims** over the **Chagos Islands** and voted in favour of **Mauritius** at the **UNGA** in **2019**.
- **India** has strengthened its ties with **Mauritius**, inaugurating an **India-built airstrip and jetty** on **Agaléga**, a dependency of **Mauritius**, earlier in **2023**, signaling growing strategic interests in the **Indian Ocean** amidst rising **Chinese influence**.

Haitian gang massacre leaves at least 70 dead: UN
Sub: IR

Sec: Places in news

Context:
- At least 70 people were killed in a series of gang attacks by the **Gran Grif gang** in Haiti, according to the **United Nations Human Rights Office**.

About Haiti:
- Located in the Caribbean, occupying the western part of the **island of Hispaniola**, which it shares with the **Dominican Republic**.
- Capital: Port-au-Prince.
- Colonized by the French in the 17th century, it became one of the wealthiest colonies due to **sugar and coffee plantations.**
- Gained independence from France in 1804, becoming the first independent nation in Latin America.

Office of the UN High Commissioner for Human Rights (OHCHR):
- The office was established by the **United Nations General Assembly in 1993** in the wake of the 1993 **World Conference on Human Rights**.
- It is commonly known as the UN Human Rights Office.
- It works to promote and protect the human rights that are guaranteed under international law and stipulated in the **Universal Declaration of Human Rights of 1948**.
- The OHCHR is led by the **High Commissioner for Human Rights.**
- It is based in Geneva and has several regional offices.

What's behind Israel's ban on the UN chief?
Sub: IR

Sec: Places in news

Context:

- Israel announced that it had **banned United Nations Secretary General (UNSG) António Guterres from entering the country.**

Reasons for the ban:

- Israel has accused him of backing Hamas, Hezbollah, the Houthis, and Iran.
- Alleged failure to unequivocally condemn Iran's missile strikes on Israel and Hamas attack on October 7, 2022.
- The ban is part of a broader Israeli argument that the UN is influenced by an **anti-Israel bloc of Arab and Islamic nations**, along with affiliated organizations like UNRWA, which Israel alleges has connections to Hamas.

Historical Precedent:

- Israel has in the past banned UN Special Rapporteurs and other senior officials accusing them of **bias against Israel** and in favour of the Palestinian side.
- However, the ban on UNSG is
- The closest instance of such an action occurred in 1950, when the USSR accused UNSG Trygve Lie of bias during the Korean crisis and threatened to veto his re-election.

UN Charter:

- **Article 100, Paragraph 2** of UN Charter says that each UN member must respect the international nature of the Secretary-General's and staff's responsibilities and refrain from attempting to influence their work.

UN Secretary-General (UNSG):

- The UNSG is the **chief administrative officer of the United Nations** and plays a crucial role in promoting peace, security, and international cooperation.
- The UNSG is **appointed by the UN General Assembly** on the recommendation of the UN Security Council.
- The UNSG operates under the principles of **neutrality and impartiality**, as outlined in the UN Charter, ensuring that decisions and actions are not influenced by member states.

A faith exiled from Russia years ago on the verge of disappearance in Georgia

Sub: IR

SEC: Places in news

Context:

- Doukhobor Community that migrated to Georgia from Russia due to religious persecution is having concerns about the loss of cultural identity and traditions due to declining membership.

About Doukhobor Community:

- A pacifist Christian sect with unique beliefs and practices, originating in 18th-century Russia.
- Founded on principles of **nonviolence and communal living**.
- They rejected Orthodox Church and military service under Czar Nicholas I.
- Russian novelist **Leo Tolstoy**, also a pacifist, who donated the profits from his final novel Resurrection to help Doukhobors emigrate to Canada.

Cultural Practices:

- Nonviolence is central to their identity, with a strong emphasis on communal support.
- Community life focuses on shared agricultural practices and self-sufficiency.
- Prayers are conducted without priests and led by community members, reflecting their grassroots spirituality.
- Hymns and prayers are traditionally passed down orally.

Expulsion:

- In **1830s,** thousands from the community were expelled from Russia for refusing **military service and allegiance to Czar Nicholas I.**
- Expelled from Russia, they settled in various regions, including Canada.
- They stablished villages in regions near the Ottoman Empire, emphasizing nonviolence and communal worship.
- At their peak, the community grew to about 20,000 members.

Current Status:

- Approximately 100 Doukhobors remain in Georgia, primarily concentrated in the villages of **Gorelovka and Orlovka** in the **South Caucasus, Georgia**.

- Significant Doukhobor populations exist in **Canada**, particularly in British Columbia, where they have established vibrant communities.

Challenges:

- The community is threatened by **assimilation pressures** as younger members, influenced by surrounding cultures, explore alternative beliefs.
- The **diminishing population** raises concerns about the survival of cultural practices and communal identity.
- In Georgia, tensions exist with ethnic Georgians and Armenians.

Kazakhs vote on the first nuclear power station in country

Sub: IR

SEC: Places in news

Context:

- Kazakhstan voted in a **referendum** on building the country's **first nuclear power station**.
- The proposed power station is to be located on the **shores of Lake Balkhash**.

Need for nuclear power:

- Kazakhstan already **imports electricity, mostly from Russia**, as its facilities, many of which are old, struggle to meet domestic demand.
- The new first nuclear power station aimed at enhancing power generation capacity and phasing out polluting coal plants.
- Kazakhstan is the **world's top uranium producer**, accounting for **43% of the world's supply** in 2022.
- However, the country does not enrich uranium to the point where it can be used as fuel.

Concerns:

- The plan has faced public criticism on concern over related hazards, the Soviet nuclear testing legacy, and fears that Russia will be involved in the project.
- Kazakhstan was part of the Soviet Union in 1986 when the **Chornobyl nuclear disaster** occurred, and tens of thousands of Kazakhs were left with lifelong health issues.
- Between 1949 and 1989, the USSR carried out **around 450 nuclear tests** in Kazakhstan, exposing 1.5 million people to radiation.

What is referendum:

- A referendum is a **direct vote** in which an entire electorate is invited to vote **on a particular proposal** and can result in the adoption of new laws or policies.
- It typically involves **issues of significant public interest** such as constitutional amendments, changes in governance, or specific legislative proposals.

Lake Balkhash:

- It is an **endorheic lake** located in Kazakhstan,
- Lake Balkhash is one of the largest lakes in Central Asia and the **15th largest lake** in the world.
- The lake is divided into two parts by the **Sarimsek Peninsula**, with the **western part containing fresh water** and the **eastern part containing saline water.**
- The **Ili River** is the main source of water for Lake Balkhash.
- The lake is shrinking and has become increasingly saline.

About Kazakhstan:

- Kazakhstan is a **landlocked country** in Central Asia. It shares borders with Russia, China, Kyrgyzstan, Uzbekistan, and Turkmenistan, with access to the Caspian Sea.
- Kazakhstan broke away from the Soviet Union to became an independent republic in 1991.

India signs $750-mn currency swap deal with forex-starved Maldives

Sub: IR

Sec: Places in news

Context:

- India signed a **$750 million currency swap agreement** with the Maldives to help the island nation tide over its current foreign currency crunch.

Details:

- India is set to extend financial assistance to the Maldives, offering $400 million through the US Dollar/Euro Swap Window.
- Additionally, ₹30 billion (about $357 million) will be provided under the INR Swap Window.
- The arrangement was signed between the Reserve Bank of India and the Maldives Monetary Authority under the **SAARC Currency Swap Framework** and is available until **2027**.

What is currency swap?
- Currency swaps are agreements between two parties to exchange one currency for another at a preset rate over a given period.
- The main purpose of currency swaps is to avoid turbulence and other risks in the foreign exchange market and exchange rate.

SAARC Currency Swap Framework:
- The **SAARC Currency Swap Framework** was established to provide **short-term liquidity support** to SAARC member countries.
- The primary purpose of this facility is to address balance of payment crises and enhance financial stability among member nations.
- Launched in **2012** and administered by the **Reserve Bank of India (RBI)**, the facility includes all SAARC members.
- This framework allows member countries to access swap arrangements in **US Dollars, Euros, or Indian Rupees**, depending on their needs. The framework provides certain concessions for swaps in Indian rupee.

Other agreements:
- Launch of the RuPay card in the Maldives.
- Handover of 700 houses built with Indian assistance.
- Agreement to enhance cooperation on trade using national currencies.
- Plans to negotiate a **Free Trade Agreement**.

Maritime and Economic Security:
- A vision statement was released for a **comprehensive economic and maritime security partnership**.
- Jointly constructed runway for the **Hanimaadhoo international airport** inaugurated.

Nile nations agree on water-sharing without Egypt's nod
Sub :IR

Sec: Places in news

Nile Basin Initiative (NBI):
- The **Nile Basin Initiative (NBI)**, a regional partnership of **10 countries,** announced that a **cooperative framework** for the **equitable use of Nile River resources** has come into effect.
- The **legal status** of the **"cooperative framework"** was confirmed by the **African Union** after **South Sudan** joined the treaty.
- **Signatory nations:**
    o **South Sudan** joined the agreement**.**
    o **Ethiopia, Uganda, Rwanda, Burundi, and Tanzania** have already **ratified** the accord.
    o **Egypt** and **Sudan** declined to sign, **Congo** abstained, and **Kenya** has not yet deposited its ratification documents.
- The **agreement aims** to ensure **sustainable and equitable usage of the Nile's water.**
- The Treaty envisages the establishment of a **permanent institutional mechanism,** the **Nile River Basin Commission (NRBC).**
    o The **Commission** would serve to promote and facilitate the implementation of the **Cooperative Framework Agreement (CFA)** and to facilitate cooperation among the **Nile Basin States** in the conservation, management and development of the **Nile River Basin** and its waters.
- **Concerns:**
    o However, its **lack of ratification by Egypt and Sudan**, which rely heavily on the **Nile's water resources,** raises concerns.
    o Both nations fear that the accord could diminish their water shares.

- o Tensions have heightened due to **Ethiopia's $4 billion Grand Ethiopian Renaissance Dam (GERD)** on the **Blue Nile,** which **Egypt** worries could **reduce water supplies** vital for irrigation and drinking water downstream unless **Ethiopia** addresses its concerns.

About the Nile River Basin:
- The **Nile River basin** is one of the most significant and historically important river systems in the world.

1. **Geography:**
- The **Nile** is the **world's longest river,** stretching approximately **6,650 kilometers (4,132 miles).**
- It flows northward through **northeastern Africa,** eventually emptying into the **Mediterranean Sea.**

2. **Major tributaries:**
- **Blue Nile:** Originates from **Lake Tana** in **Ethiopia**
- **White Nile:** Begins in the **Great Lakes region** of **central Africa**
- The **White and Blue Niles** merge at **Khartoum,** the capital of **Sudan.**

3. **Countries involved:** The Nile basin includes **11 countries:** Egypt, Sudan, South Sudan, Ethiopia, Uganda, Kenya, Tanzania, Rwanda, Burundi, Democratic Republic of Congo, and Eritrea.

4. **Historical importance:**
- **Ancient Egyptian civilization** developed along the **Nile's banks.**
- The river has been crucial for agriculture, transportation, and development for thousands of years.

5. **Environmental concerns:**
- Climate change impacts on water availability
- Pollution and ecosystem degradation

India and Russia Collaborate on Northern Sea Route and Polar Navigation

Sub :IR

Sec :Places in news

Why in News

India and Russia are deepening their cooperation on the **Northern Sea Route (NSR)** through joint projects in Arctic shipbuilding, training Indian sailors for polar navigation, and cargo transit. The discussions come at a time when India is enhancing its investments in **Russia's Far East region** and working on major transport corridors like the **Chennai-Vladivostok Maritime Corridor** and the **International North-South Transport Corridor (INSTC).**

What is Northern Sea Route (NSR)?

The **Northern Sea Route (NSR),** the **shortest shipping route** for freight transportation between **Europe** and **countries of the Asia-Pacific region,** straddles **four seas** of the Arctic Ocean.

Running to **5,600 km**, the **Route begins** at the boundary between the **Barents** and the **Kara seas (Kara Strait)** and **ends** in the **Bering Strait (Provideniya Bay)**.

The distance savings along the **NSR** can be as high as **50%** compared to the currently used shipping lanes via **Suez or Panama**.

Federal Project: Russia is working on the **"Great Northern Sea Route"** project to create a seamless transport corridor from **St. Petersburg and Kaliningrad to Vladivostok.**

Arctic Infrastructure: Russia is investing in **nuclear icebreakers and updating the NSR's infrastructure** to make it an efficient shipping artery linking Europe, Russia, and the Asia-Pacific region.

How is Russia making the NSR navigable?
- As the seas of the Arctic Ocean remain icebound during most of the year, the **icebreaking assistance** is organized to ensure **safe navigation** along the NSR.
- **Russia is the only country in the world** with a **nuclear-powered icebreaker fleet**.
- In **December 1959,** the **world's first nuclear icebreaker, "Lenin,"** was put into operation. It was **decommissioned 30 years later.**
- Today, **FSUE Atomflot**, a subsidiary of **Rosatom**, acts as the fleet operator of nuclear-powered icebreakers.

India-Russia Cooperation on the Northern Sea Route (NSR):
- **Cargo Transit:** Identifying targets for **Indian-Russian cargo movement** along the NSR.
- **Training of Indian Sailors:** The potential for training Indian sailors in polar navigation techniques.
- **Arctic Shipbuilding:** Collaborative development of projects focused on **Arctic shipbuilding technology.**
- **Memorandum of Understanding (MoU):** A draft MoU between India and Russia was proposed to enhance cooperation in cargo shipping along the NSR.

- **Rosatom, Russia's state nuclear energy corporation,** acts as the infrastructure operator for the NSR since 2018.

About Chennai-Vladivostok Maritime Corridor:
- The **Vladivostok – Chennai route** passes through the **Sea of Japan, the South China Sea and Malacca Strait.**
- The route will bring down transport time to **12 days,** almost **a third of what is taken under the existing popular route** that covers **St Petersburg to Mumbai**.
  - The current maritime route, **St Petersburg to Mumbai,** is said to be an **8,675 nautical mile (16,000 km)** one.
  - Against this, the proposed **Vladivostok – Chennai route** is said to be **5647 nautical miles (10,500 km) long.**
- Costs are expected to reduce by 30%.
- **Significance of the new route:** The new route would also give India access to the Far East, including countries like Mongolia, and the largest presence in the South East Asian region.

About International North-South Transport Corridor (INSTC):
- Proposed in **2000,** the **INSTC** was designed as a **transport route** from **India to Russia via Iran,** offering an **alternative** to the **conventional Suez Canal route**.
- The **corridor** spans **7,200 km** incorporating **sea, rail, and road components,** crossing multiple countries and **aimed** at enhancing **India's access to Central Asian and Eurasian markets**.
- **Planned route:** The **INSTC** envisages the movement of goods from **Mumbai** to **Bandar Abbas** in **Iran** by sea; from **Bandar Abbas** to **Bandar-e-Anzali,** an **Iranian port** on the **Caspian Sea,** by road; from **Bandar-e-Anzali** to **Astrakhan**, a **Caspian port** in the **Russian Federation** by ship across the **Caspian Sea;** and onward to other **parts of the Russian Federation** and **Europe** by **rail**.
- **Participating Countries:** Besides **India, Russia,** and **Iran,** countries such as **Azerbaijan, Armenia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Ukraine, Belarus, Oman,** and **Syria** have signed onto the project. **Bulgaria** has joined as an observer state.

China holds military drills near Taiwan: all about the shared history, current tensions

Sub :IR

Sec: Places in news

Context:
- On October 14, 2023, China initiated military exercises near Taiwan, termed **'Operation Joint Sword 24B'**, shortly after **Taiwan's 113th National Day**.
- The military exercises are a continuation of longstanding tensions.

Background:
- Since the 1949 Chinese Civil War, Taiwan has operated as a **sovereign, self-administered** entity, officially known as the **Republic of China (RoC).**
- The PRC views Taiwan as a **breakaway province** that must eventually be reunified with the mainland under its One China policy.

Chinese Position:
- China claims the exercises are a response to Taiwan President's remarks during his National Day address on October 10, where he affirmed Taiwan's sovereignty and stated that the **People's Republic of China (PRC) cannot represent Taiwan**.
- The **People's Liberation Army (PLA)** has characterized these actions as a **stern warning** against what it perceives as **separatist tendencies** of Taiwan.

Taiwan's Position:
- Taiwan's government has committed to addressing the perceived threats from China and urged China to halt military provocations that undermine regional stability, calling for peaceful relations and mutual respect for democracy.

Taiwan's Global Significance:
- Taiwan's strategic location in the **East China Sea** makes it critical for regional stability, especially concerning Southeast Asia.
- Tensions in the Taiwan Strait could disrupt trade and escalate conflicts in neighbouring areas, such as the South China Sea.

International recognition:
- Only 11 countries officially recognize Taiwan, primarily small island nations.
- Most nations adhere to the **One China policy**, recognizing the PRC's claim over Taiwan, despite informal relations with the RoC.

Historical relations between China and Taiwan:

- The Chinese Communist Party's victory in the 1949 Chinese civil war resulted in its rival, the Kuomintang (KMT), relocating to Taiwan where its leader, Chiang Kai Shek, ruled as President until his death in 1975.
- Since then, the island became a non-communist bastion against the PRC.
- In the 1990s, relations improved, leading to increased trade, despite ongoing tensions.
- As the British prepared to exit Hong Kong in 1999, the **One China, Two Systems** solution was offered to Taiwan as well, but it was rejected by the Taiwanese.
- Taiwan's current political landscape features the Democratic Progressive Party (DPP) advocating for independence and the KMT, which supports closer ties with China.
- The DPP and KMT are primarily the political parties representing the **Hakka population** of the island and the **mainland Chinese minority**, respectively.
- Recent years have seen a **shift towards pro-independence sentiments**, particularly under President Tsai Ing-wen since 2016.

West Asia 'conflagration' to top agenda at first European Union-Gulf summit

Sub : IR

Sec : Places in news

Context:
- The **European Union (EU) and Gulf Cooperation Council (GCC)** leaders are set to convene in Brussels, focusing primarily on avoiding a broader conflict in West Asia.
- This summit will involve heads of state and government from six Gulf nations along with representatives from the 27 EU member states.

Agenda:
- While trade, energy, and climate change are on the agenda, the **escalating conflicts involving Israel, particularly in Gaza and Lebanon**, are expected to dominate discussions.
- EU officials have indicated that preventing a larger regional conflict is a primary concern.
- Both the EU and GCC countries share a mutual interest in de-escalation and the establishment of peace in the region. The EU has called for a ceasefire in Lebanon and Gaza.

Changing alliances:
- Traditionally aligned with Western powers, the Gulf monarchies have **recently grown closer to Iran**.
- The GCC nations have consistently advocated for the **establishment of a Palestinian state** alongside Israel and have been involved in negotiations to secure ceasefires.

Trade relations:
- The European Union is seeking to foster closer ties with GCC countries.
- Although the **EU is the GCC's second-largest trading partner**, discussions surrounding a potential trade pact have stalled.

Gulf Cooperation Council (GCC):
- The GCC is a political and economic alliance of six countries in the Arabian Peninsula: **Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates**.
- Established in 1981, the GCC promotes economic, security, cultural and social cooperation between the six states and holds a summit every year to discuss cooperation and regional affairs.

Argentina's La Rioja Province Introduces 'Chachos' as Emergency Tender Amid Austerity Measures

Sub: IR

Sec: Places in news

Introduction of 'Chachos':
- **Chachos** are newly introduced **emergency tender** in La Rioja, **not a part of the national currency** (Argentine pesos) or U.S. dollars.
- These are **initiated by the left-wing populist governor** of La Rioja as a response to economic challenges.
- **Reason for Introduction**:
  - The move came after **far-right President Javier Milei** implemented **austerity measures**, reducing **federal budget transfers** to provinces, which led to a **financial crisis** in La Rioja.

- - - **La Rioja** heavily depends on **federal taxes**, covering **90% of its provincial budget**, and public payroll makes up **two-thirds of the registered workforce**.
- **Usage and Acceptance of Chachos**:
    - **"Chachos accepted here"** decals are visible across **supermarkets, gas stations, restaurants, and hair salons** in La Rioja's capital.
    - The local government has ensured a **1-to-1 exchange rate** with pesos.
    - Chachos can be used for **tax payments** and **utility bills** within La Rioja.
- **Limitations**:
    - **Chachos cannot be used outside La Rioja**, making them **limited in circulation**.
    - Only **registered businesses** can exchange chachos for pesos at **government-approved exchange points**, adding a level of **regulation** to their use.
- **Impact of Austerity Measures by President Milei**:
    - After **assuming office in December 2023**, President **Milei imposed 'shock therapy'** aimed at curbing **budget deficits** stemming from years of populist spending.
    - These cuts have affected **all 23 provinces** but led to a **full-blown crisis in La Rioja**, given the province's dependency on federal funds.
- **Implications**:
    - The introduction of chachos is a **temporary measure** to address **local liquidity issues** and maintain **economic stability** amid federal cutbacks.
    - It highlights the **strained relations** between local and federal governments and raises questions about the **long-term sustainability** of such emergency currencies.

In summary, the **economic challenges** in La Rioja have led to the **creation of a local tender**, 'chachos', to maintain **economic activities** amid severe federal budget cuts, reflecting **regional responses** to national austerity policies.

In mega tourism event, Saudi Arabia celebrates Indian diversity, pluralism
Sub: IR

Sec: Places in news

Context:

- Saudi Arabia recently hosted a **fortnight-long celebration of Indian culture** as part of the annual Riyadh Season festivities.

Details of the event:

- This event is part of the **Global Harmony Initiative** launched by the Saudi government, aiming to promote cultural exchange and tourism.
- Events included musical performances, outdoor culinary experiences, and participation from Indian performers and sportspersons.
- The change in the Saudi society was reflected during the event with the widespread participation of Saudi women.

About Global Harmony Initiative:

- The Global Harmony Initiative is a program launched by the Saudi government aimed at **promoting cultural exchange** between diverse cultures and nations.
- It also aims to **boost tourism** in Saudi Arabia by showcasing its rich cultural heritage and to **strengthen diplomatic ties** and cooperation with other countries.
- The initiative includes festivals, exhibitions, and performances that highlight the richness of various cultures.
- It reflects the Kingdom's vision of modernization and social reform, promoting **inclusivity and diversity.**

Indian Community in Saudi Arabia:

- Currently, Saudi Arabia is home to approximately **4 million Indian workers**, making the Indian community the **second largest** in the country, following the **Bangladeshi community**, which numbers around 2.7 million.
- The growing Indian presence reflects the strong ties and collaboration between India and Saudi Arabia.

Rising polio cases shadow vaccination campaign in Pak.
Sub: IR

Sec: Places in news

Context:

- Polio cases in Pakistan have seen a concerning increase, with health officials confirming **39 new cases since January 2023**.
- This is a significant rise compared to only six cases reported in the same period last year.
- The country is preparing for a new vaccination campaign starting on October 28, aimed at vaccinating at least 32 million children and making Pakistan a polio free state.

Challenges to vaccination:
- **Violence against health workers and the police** tasked with protecting them has severely hampered vaccination efforts in Pakistan.
- Health workers often face threats and attacks from militants who propagate false narratives about the vaccines being a **western conspiracy to sterilize children**. This hostility poses a significant barrier to eradicating polio.
- The **Taliban recently decided to halt a door-to-door vaccination campaign** in Afghanistan. Given the close cross-border movement between the two countries, this decision could have severe repercussions for Pakistan's polio eradication efforts.

Geographical Concerns:
- The majority of new polio cases have emerged from **Balochistan and Sindh** provinces, followed by **Khyber Pakhtunkhwa and Punjab**.
- This shift in the geographic distribution of cases is alarming, especially since previous outbreaks were primarily concentrated in the **northwest region bordering Afghanistan**.

About Polio:
- Polio, or poliomyelitis, is a highly infectious **viral disease** caused by the poliovirus.
- It primarily affects **children under five** and can lead to paralysis, disability, or even death.
- There is no cure for the disease, but it can be prevented with the polio vaccine.
- **Symptoms:** In most cases, **mild symptoms like fever, fatigue** or no symptoms. However, in severe cases it can lead to **paralysis and death.**
- **Transmission:** The virus spreads through oral-faecal route. Direct person-to-person contact can also transmit the virus.
- **Prevention:** Vaccination is the most effective way to prevent polio. **Two types of vaccines** Inactivated poliovirus (IPV) and Oral polio vaccine (OPV) are available against polio virus.

Current Status:
- Polio has been **eradicated in most parts of the world**, with only a few countries, notably **Afghanistan and Pakistan** reporting **ongoing transmission**.
- Afghanistan and Pakistan are the two countries in which the spread of polio has never been stopped.

If PKK's Ocalan renounces violence, he may get parole, says Erdogan ally Bahceli

Sub : IR

Sec: Places in news

Context:
- The leader of Turkiye's far right nationalist party that's **allied with President Recep Tayyip Erdogan** raised the possibility of parole for **Abdullah Ocalan**, the imprisoned leader of the militant Kurdish group **Kurdistan Workers' Party (PKK)**.
- This development comes amidst speculation about President **Recep Tayyip Erdogan** seeking support from pro-Kurdish political factions.

Details:
- Bahceli suggested that Ocalan could be granted parole if he **renounces violence and disbands the PKK**.
- The proposal is linked to Erdogan's efforts to engage Turkiye's pro-Kurdish party, **Peoples' Equality and Democracy Party (DEM)**, to facilitate constitutional changes.
- The DEM, the third-largest party in Parliament, has long advocated for better conditions for Ocalan, who has been serving a life sentence in isolation on an island near Istanbul since 1999.

Need for constitutional changes:
- The existing constitution **restricts Erdogan from seeking re-election** unless early elections are called.
- Changes could potentially allow Erdogan to extend his rule beyond the current constitutional limits, as he has been **in power since 2003**.

Background on PKK:

- The **Kurdistan Workers' Party**, or PKK is a Kurdish militant political organization, originally founded in 1978 by the Marxist revolutionary **Abdullah Ocalan**.
- It emerged from a leftist ideology and aimed to establish **an independent Kurdish state** in southeastern Turkey.
- The PKK has been engaged in an **armed struggle for autonomy in southeastern Turkiye** since 1984, leading to significant violence and loss of life, with tens of thousands affected.
- The group is classified as a **terrorist organization** by **Turkiye and its Western allies**.

Russia's move to ratify North Korea defence pact irks Seoul
Sub : IR

Sec : Places in news

Context:
- Russia recently took significant steps to ratify a key **defence treaty with North Korea**.
- This pact, which includes provisions for **mutual assistance in the face of aggression**, was unanimously approved by Russia's Lower House of Parliament.
- The treaty will now proceed to the Upper House, the Federation Council, for final approval.

Concerns over troop deployments:
- In light of the ratification, South Korea expressed serious concerns regarding the potential deployment of North Korean troops to support Russian military efforts in Ukraine.
- According to South Korea's spy agency, thousands of North Korean soldiers are currently undergoing training in Russia, and there are indications that more troops could be sent to the frontlines in Ukraine by December.

South Korea's response:
- South Korean President Yoon Suk Yeol emphasized that the country would not remain passive in response to the situation.

Russia-North Korea relations:
- Historically, North Korea and Russia (then the Soviet Union) were **allies during the Cold War,** sharing ideological ties.
- After the Soviet Union's collapse, relations became strained but maintained a level of diplomatic engagement.

Current scenario:
- The partnership between Pyongyang and Moscow has noticeably **strengthened since Russia's military offensive in Ukraine** began in 2022.
- Many in the West believe that North Korea is already supplying weapons to Russia to support its military efforts.
- The ratification of the defence pact between Russia and North Korea, along with reported troop movements, indicates a deepening alliance that raises concerns for South Korea and the international community.

Saudi Arabia opens resort island at futuristic mega-city
Sub: IR

Sec: Places in news

Context:
- Saudi Arabia's ambitious mega-city project, **NEOM**, recently announced the opening of its first physical showcase, **Sindalah**, **a luxury island in the Red Sea**.
- This initiative is part of the country's broader efforts to diversify its economy and promote luxury tourism.

NEOM Project:
- NEOM aims to support Saudi Arabia's **Vision 2030**, which seeks to position the country for a post-oil economy by enhancing sectors like tourism and technology.
- **The Line**: NEOM is also known for **the Line**, **a linear city** comprising twin skyscrapers extending **170 km** along the coast, expected to accommodate over **one million residents by 2030**, with projections rising to **nine million by 2045**.

About Vision 2030:
- It is Saudi Arabia's national strategy aims to **reduce the kingdom's dependence on oil by diversifying its economy** and developing sectors like tourism, entertainment, and renewable energy.

How the United States' electoral college works
Sub : IR

Sec :Places in news

Overview of the Electoral College:

- The Electoral College is a unique system used in the United States to elect the President and Vice President. It allows for electors, chosen based on the popular vote in each state, to formally cast votes for these candidates.
- The U.S. is the only democracy where a candidate can win the popular vote but still lose the presidency, a situation that has occurred four times, notably in 2000 and 2016.

Structure of the Electoral College:

- The Electoral College consists of **538 electors**, with a **majority of 270** electoral votes needed to win the presidency.
- Each state has a number of electors equal to its total Congressional delegation (House Representatives + 2 Senators). California has the most electors (54), while six states, including Wyoming and Vermont, have the smallest allocation (3 electors).

Selection of Electors:

- Political parties select a slate of electors prior to the election, typically comprised of dedicated party members and affiliates.
- The U.S. Constitution specifies that certain individuals, such as **members of Congress and federal officeholders**, cannot serve as electors.
- While electors usually vote for their party's candidate, there are no federal laws requiring them to do so.

Election of Electors:

- The Electoral College is effectively chosen through the popular vote during the presidential election on November 5.
- On Election Day, **voters cast ballots for their preferred presidential candidate**, **which actually elects the electors pledged to that candidate.**
- Most states use a **winner-takes-all system,** where the candidate with the most votes in a state receives all of that state's electoral votes, except in Maine and Nebraska, which use a proportional system.

Role of Electors:

- Electors meet in their state capitals in December to cast their votes for President and Vice President, a process largely seen as a formality.
- Most electors vote according to the popular vote, though there is no federal mandate requiring them to do so. Some states impose penalties for faithless electors who do not vote as pledged.

Polity

Who is an Overseas Citizen of India? What are the rights and privileges of OCI card holders?

Sub :Polity

Sec: Constitution

Context:

- Recently, false reports were circulating on social media regarding **OCIs becoming reclassified as "foreigners"** in India.
- Consulate General of India in New York clarified that the provisions of a gazette notification from 2021 continue to remain in force, and that no new change has been introduced in the recent past for OCI card holders.

What is an OCI card?

- An **OCI (Overseas Citizen of India)** card is a form of citizenship status offered to **individuals of Indian origin** who are **citizens of other countries**, under **Section 7A of the Citizenship Act 1955.**
- It was introduced in 2005 with an aim to provide **dual citizenship for the Indian diaspora.**
- If an individual is registered as an OCI for a period of five years, he/she is eligible to apply for Indian citizenship.

Eligibility:

- It is available to people who were Indian citizens or their descendants. This includes children and grandchildren of Indian citizens.
- The **spouse of foreign origin** of a citizen of India or an OCI, whose marriage has been registered and subsisted for **not less than two years**, can apply for an OCI card.
- An applicant is **not eligible** to get an OCI card if his/her parents or grandparents have **ever been a citizen of Pakistan or Bangladesh.**
- Foreign military personnel either **in service or retired** are not entitled for grant of OCI.

Benefits:

- Multiple entry, life-long visa for visiting India.
- No restrictions on the length of stay in India.

- Access to various economic, financial, and educational benefits, similar to Indian citizens.

Restrictions:
- The OCI card holder is **not entitled to vote**, be a member of a Legislative Assembly or a Legislative Council or of Parliament.
- OCI **cannot hold Indian constitutional posts** such as that of the President, Vice President, Judge of the Supreme Court or High Court.
- He or she cannot normally hold employment in the government.

Current Status:
- As per government records, there were more than **45 lakh registered OCI card holders in 2023, from 129 countries**.
- The **US topped the list with over 16.8 lakh OCI card holders**, followed by the UK (9.34 lakh), Australia (4.94 lakh) and Canada (4.18 lakh).

Recent amendment:
- In 2021, the **Ministry of Home Affairs** issued a gazette notification amending the rules regarding OCI card holders.
- The amendment put OCIs at par with **"foreign nationals"** under the Foreign Exchange Management Act (FEMA).
- Earlier, OCI card holders **had general parity with Non-Resident Indians (NRIs)** in economic, financial, and educational fields, except for agricultural property.
- It required OCI card holders to seek **permission or a permit to visit protected areas** in India. Special permit is also needed for research and missionary activities.

Previous amendments:
- OCI rules have been amended in **2005, 2007 and 2009** prior to this.
- **2005**: Established multiple-entry visas and exemptions from FRRO registration.
- **2007**: Parity with NRIs for inter-country adoption, airfare on domestic flights, and entry fees to wildlife parks.
- **2009**: Parity with NRIs for monument entry fees, professional opportunities, and eligibility for all-India tests.

How India's temples are run

Sub :Polity

Sec: Constitution

Context:
- Supreme Court hears petitions seeking a **court-monitored probe** into the alleged adulteration of the **ghee in Lord Venkateswara's laddu prasadam,** Hindu organisations have revived their demand to **free temples from government control**.

Current situation:
- Many **Hindu, Sikh, Jain,** and **Buddhist places of worship** are under **government control.**
  - **Hindu temples** form the majority of the around **30 lakh places of worship** in India (2011 census).
- **Muslims** and **Christians** manage their own religious institutions.
- Several states have laws giving the government power to **administer temples, their incomes, and expenditures**.
  - Temples in **Tamil Nadu** are managed by the **state's Hindu Religious and Charitable Endowments (HR&CE) department.**
  - The **AP government** controls and appoints the head of the **Tirumala Tirupati Devasthanams (TTD),** which runs the **Tirupati Temple**.
  - The erstwhile state of **Jammu and Kashmir** enacted **The Jammu and Kashmir Shri Mata Vaishno Devi Shrine Act, 1988**, to manage, specifically, the Vaishno Devi Mata Shrine in Katra, Jammu.

Historical Context:
- The construction of monumental temples dates back to the **Mauryan period (321-185 BCE).**
- **Government control** dates back to the colonial era when the **British enacted laws to interfere in temple administration**.
  - In **1863,** the **British** enacted the **Religious Endowments Act**, which handed over control of temples to committees set up under the Act.
- **Post-independence,** states enacted their own laws, the first of which was the **Madras Hindu Religious and Charitable Endowments Act 1951.**

Constitutional Basis:
- **Article 25(2)** of the **Constitution** allows the government to regulate religious practices and institutions.

- o **Article 25 (2)** states that a government can make laws "regulating or restricting any economic, financial, political or other secular activity which may be associated with religious practice", and "providing for social welfare and reform or the throwing open of Hindu religious institutions of a public character to all classes and sections of Hindus".
- **Religious endowments** are on the **Concurrent List (List III),** allowing both Centre and states to legislate.

Legal Positions:
- Courts have generally upheld the **state's right to regulate religious institutions.**
- Key cases include the **1954 Shirur Mutt case** and the **1996 Pannalal Bansilal Pitti case**.

Shirur Mutt case (1954):
- Established that laws completely removing administrative rights from religious denominations violate Article 26(d) of the Constitution.
- However, it also affirmed the state's general right to regulate the administration of religious or charitable institutions.
- This case set a precedent for balancing religious autonomy with state oversight.

Ratilal Panachand Gandhi vs. The State of Bombay (1954):
- Reaffirmed that the right of religious bodies to manage their affairs is a fundamental right.
- Clarified that while this right cannot be taken away entirely, the state can regulate the administration of trust properties through valid laws.
- This ruling further defined the limits of state intervention in religious affairs.

Pannalal Bansilal Pitti vs State Of Andhra Pradesh (1996):
- Upheld a law abolishing hereditary rights over the chairmanship of trusts administering Hindu religious institutions.
- Rejected the argument that laws regulating religious institutions must apply uniformly to all religions.
- This decision allowed for religion-specific regulations, recognizing that different religious communities may require different approaches.

India slipped on academic freedom index over the past decade: report
Sub: Polity

Sec: Constitution

Context:
- The **"Free to Think 2024"** annual report, published by the **Scholars at Risk (SAR) Academic Freedom Monitoring Project**, indicates a significant decline in India's academic freedom over the past decade.
- SAR is a network of 665 universities across the globe.
- The report analysed **391 attacks** on higher education communities across **51 countries** between **July 1, 2023, and June 30, 2024**

About the Academic Freedom Index:
- The **Academic Freedom Index (AFI)** is a tool designed to assess and measure the level of academic freedom in various countries around the world.
- It is published by **Global Public Policy Institute** as a part of a global time-series dataset (1900-2019) in collaboration with **Scholars at Risk (SAR) and V-Dem Institute** (Varieties of Democracy).
- The scores **are scaled from 0 (lowest) to 1 (highest)**
- **Indicators:**
  - o Freedom to research and teach
  - o Institutional Autonomy
  - o Freedom of academic exchange and dissemination
  - o Campus integrity
  - o Freedom of academic and cultural expression

Decline in India's performance:
- India's score on the Academic Freedom Index dropped from **6 points in 2013 to 0.2 points in 2023.**
- This score categorizes India as **"completely restricted",** marking its lowest point since the mid-1940s.

Threats to Academic Freedom:
- Government's attempts to exert political control over universities.

- There is an imposition of a **Hindu nationalist agenda** on educational policies, alongside limitations placed on student protests.
- **Restrictions Imposed by Institutions**:
    o Notable universities such as **Jawaharlal Nehru University (JNU)** and **South Asian University (SAU)** implemented new policies that restrict student expression.
    o JNU has barred protests near academic buildings.
    o SAU has prohibited protests on campus altogether.
- **Political Conflicts**:
    o The BJP-led Union government has engaged in disputes with state governments over the control of higher education.
    o In **Kerala**, a conflict arose when Governor **Arif Mohammed Khan** opposed a legislative amendment that would replace him as Chancellor of state universities.
    o Similar struggles for control of higher education have occurred in other states, including **Tamil Nadu**, **West Bengal**, and **Punjab**.

On 'casteist' provisions in prison manuals

Sub: Polity

Sec: Constitution

Context:
- On October 3, the **Supreme Court of India** declared the **caste-based division of labour in prisons to be unconstitutional.**
- A three-judge Bench, led by Chief Justice **Y. Chandrachud**, struck down various provisions in State prison manuals that reinforced caste inequalities, deeming them violative of prisoners' fundamental rights.

Background of the case:
- The ruling stemmed from a **Public Interest Litigation (PIL)** filed by journalist **Sukanya Shantha**, which highlighted provisions in prison manuals from several states including **Uttar Pradesh**, **West Bengal**, **Odisha**, **Maharashtra**, **Tamil Nadu**, and **Kerala**.
- These provisions legitimized caste-based inequalities. For instance:
    o In **Palayamkottai Central Jail** (Tamil Nadu), prisoners from different castes like Thevars, Nadars, and Pallars were segregated into separate sections, showcasing blatant caste-based segregation.
    o The **Rajasthan Prison Rules, 1951**, assigned latrine duties to the **Mehtar** caste (a Scheduled Caste) while higher-caste prisoners were given roles in kitchens, perpetuating caste divisions.

Colonial Legacy in Prison Manuals
- The **Criminal Tribes Act, 1871**, allowed the British to label certain marginalized communities as **criminal tribes**, perpetuating the notion of **born criminals**.
- After the act was repealed, these communities were categorized as **denotified tribes**.
- However, prison manuals continued to label them as **habitual offenders** without any conviction.

Examples cited by Supreme court:
- The **West Bengal Jail Code** required that convict overseers be chosen based on their caste, specifically excluding those from **wandering tribes.**
- Manuals in **Andhra Pradesh**, **Tamil Nadu**, and **Kerala** defined habitual criminals broadly, stigmatizing entire communities.

Violation of Fundamental Rights:
- The manuals were found to be in violation of **Article 14** (right to equality). The segregation based on caste would reinforce social divisions, contrary to the principles of equality.
- The assignment of labour based on caste, where marginalized communities were given menial tasks while higher castes were allowed to engage in cooking, constitutes **direct discrimination under Article 15(1)**.
- The practice of assigning roles based on "customary" notions leads to **indirect discrimination**, violating the dignity and reformation rights of marginalized prisoners.
- The Court noted that labelling tasks based on caste not only perpetuates untouchability (prohibited under **Article 17**) but also restricts the reformation and dignity of prisoners, thereby violating their right to life.

Directions issued:

- The Supreme Court directed all States and Union Territories to amend their prison manuals and rules within **three months** to eliminate discriminatory practices.
- Necessary reforms were mandated for both the **Model Prison Manual, 2016** and the **Model Prisons and Correctional Services Act, 2023**.
- To ensure compliance, **district legal services authorities** and **boards of visitors** were tasked with conducting regular inspections of prison practices.

On Samsung workers' right to unionise
Sub : Polity

Sec: Constitution

Context:
- The protests by Samsung India workers in Sriperumbudur, Tamil Nadu, centre around their **fundamental right to form a registered trade union** for collective bargaining to improve their employment conditions.

State Government's Response:
- In response to the protests that began on September 9, the Tamil Nadu government established a **workmen committee** to address the situation and **employed police force** to suppress the strike.
- Legal experts criticize this action, arguing it should have prioritized the registration of the **Samsung India Workers Union (SIWU)** as per the **Trade Unions Act, 1926**.

Implications:
- Vaigai, a labour law expert, emphasized that the registration of the SIWU should have come before the formation of the workmen committee.
- The police intervention, instead of facilitating a democratic process for collective bargaining, gives the impression of government bias towards Samsung management.
- Samsung has contested SIWU's registration, alleging CITU (Centre of Indian Trade Unions) backing.

Right to Form Associations:
- The Supreme Court upheld the right to form unions as a **fundamental right under Article 19(1)(c)** of the Indian Constitution.
- Any restrictions on this right must be reasonable and not arbitrary, primarily focusing on **public order and morality**.
- The obligation lies with the state to register trade unions and ensure workers can voice their demands.

Collective Bargaining:
- Collective bargaining is recognized in the **Industrial Disputes Act** and involves negotiations between employers and employees regarding working conditions.
- Historically rooted in struggles for basic worker rights, collective bargaining evolved post-World War II, contributing significantly to workers' rights and social justice.
- Refusal by employers to engage in good faith bargaining is classified as **unfair labour practice** under Indian law.
- **International Perspectives:** The ILO defines collective bargaining as negotiations aimed at determining employment terms.

Right to Strike:
- Strikes are recognized as a **legal right within certain constraints** under the **Industrial Disputes Act.**
- The Supreme Court considers strikes an essential form of demonstration for workers.
- While the right to strike is acknowledged globally, it is **not absolute** and is subject to regulations, including advance notice requirements.

Criticism of the Workmen Committee:
- Workers criticized the government's workmen committee for allegedly favouring the company, highlighting that such committees should consist of **equal representation from both workers and employers**.
- The Industrial Disputes Act mandates that workers in the committee be chosen in **consultation with any registered trade union**.

Trademark Issues:
- Samsung has raised concerns about the **use of its name in the SIWU**, claiming it violates the **Trade Marks Act, 1999**.
- However, trade unions are defined differently under the Trade Unions Act, 1926, focusing on worker-employer relations, thus exempting them from being classified as business entities under trademark laws.

SC to deliver verdict on Section 6A of the Citizenship Act 1955

Sub : Polity

Sec: Constitution

Context:

- A Constitution Bench led by Chief Justice D.Y. Chandrachud is set to pronounce judgment regarding the constitutionality of **Section 6A** of the **Citizenship Act, 1955**.

Section 6A of the Citizenship Act:

- Introduced as part of the **Assam Accord** signed on August 15, 1985, by the Rajiv Gandhi government.

Provisions:

- Foreigners who entered Assam before **January 1, 1966** and been **ordinarily resident** will have all the rights and obligations of Indian citizens.
- Those entering between **January 1, 1966**, and **March 25, 1971** receive the same rights but cannot vote for **10 years**.

Assam Accord:

- It was a tripartite accord signed between the Government of India, State Government of Assam and the leaders of the Assam Movement in 1985.
- It led to the conclusion of a six-year agitation launched by the All Assam Students' Union (AASU) in 1979, demanding the identification and deportation of illegal immigrants from Assam.
- It sets a cut-off of midnight of 24th March 1971, for the detection of illegal foreigners in Assam.

About the case:

- The petitioners had questioned **why Assam alone**, among the border States, had been singled out to implement Section 6A.
- Petitioners argue that Section 6A contributes to a **rise in infiltration** and **demographic changes** that threaten Assamese cultural identity.
- The **court has requested evidence from petitioners** to demonstrate how granted to cross-border migrants between 1966 and 1971 resulted in significant demographic shifts.

Saudi Arabia launches new digital platform to ensure wage protection

Sub: Polity

Sec: Constitution

Context:

- Saudi Arabia is implementing a series of digitally enforceable measures aimed at improving **working conditions for foreign workers,** including those from India.
- These measures align with the Kingdom's **Vision 2030 goals**, focusing on labour rights and reducing **illegal immigration**.

Musaned Platform:

- The Musaned platform is a key component of the new labour regulations. It serves as a digital tool designed to benefit foreign workers in various sectors, particularly in domestic work.
- The Musaned platform is designed to safeguard human rights and ensure a **stable working environment** for both **employees and employers**.

Key Features of the platform:

- **Easier access:** Foreign workers can access and monitor their **employment contracts** through the Musaned platform.
- **Mobile App:** A dedicated **Musaned labour app** provides real-time updates regarding employment conditions and rights.
- **Social security:** The platform can be linked with contract insurance and health benefits, ensuring comprehensive support for workers.
- **Financial Transaction Tracking:** An essential feature of the Musaned platform is its ability to track financial transactions between employers and foreign workers. This ensures that employers meet their contractual obligations, providing an additional layer of security for workers.

Global Harmony Initiative:

- Saudi officials officially launched the Global Harmony Initiative which is a part of Saudi Arabia's broader **Quality of Life programme** to attain its Vision 2030 objectives.
- It aims at promoting quality of life and developing stronger bonds between the local society and the Indian and other expatriate communities through cultural promotion.

- The initiative seeks to showcase the diverse cultures of expatriates and highlight their harmonious existence within Saudi society.

About Vision 2030:
- Launched in 2016, Vision 2030 is a blueprint for diversifying the economy, empowering citizens, creating a vibrant environment for both local and international investors, and establishing Saudi Arabia as a global leader.
- There are three stages to the programme, each lasting five years.

Indian community in Saudi:
- Indians are the **largest expat community** in Saudi Arabia with an approximate **6 million** people.
- The community has increased by about **200,000 people** over the past year.

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Child betrothals are a ploy to escape punishment: SC
Sub : Polity

Sec: Constitution

Context:

- The Supreme Court of India recently ruled that **child betrothals**, often used as a **tactic to evade punishment** under the Prohibition of Child Marriage Act (PCMA), are a **violation of basic rights**, including freedom of choice, personal autonomy, and the right to a childhood.
- The court's ruling was based on petitions filed by NGOs like the **Society for Enlightenment and Voluntary Action**.
- The NGOs noted that despite the enactment of the PCMA almost two decades ago, child marriage rates remain alarmingly high.

Observations by the court:
- **Vagueness of the Law:** The court observed that the current child marriage laws are vague regarding child betrothals.
- The court urged Parliament to explicitly outlaw child betrothals and classify a child whose **marriage is arranged as a minor** as in **need of care and protection** under the Juvenile Justice Act.
- It also highlighted that India has yet to fully address the issue of minor betrothals despite international commitments, such as the **Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)** adopted in 1979.

Conflict with modern laws:
- The court warned that the centuries-old practice of child marriage poses a threat to modern laws like the **Protection of Children from Sexual Offences (POCSO) Act.**
- The institution of child marriage, the court stated, directly facilitates sexual abuse of child brides by design.

Impact of child marriage on both genders:
- The court recognized that boys suffer alongside girls in child marriages. Patriarchal notions of masculinity, misinformation, and peer pressure often lead boys into violent behaviour against their young brides.

Clash between Personal Laws and Child Marriage Prohibition:
- The Supreme Court pointed out the confusion regarding how personal laws interact with the prohibition of child marriage.
- The Centre had submitted a note pushing for the PCMA to take precedence over personal laws but did not follow up by providing records of conflicting High Court judgments on the matter.

Definition of child:
- Under the **Prohibition of Child Marriage Act (PCMA), 2006**, girls under 18 and boys under 21 are considered children, and child marriage is a punishable offense.
- The law views child marriage as a criminal act.

Guidelines Issued by the Supreme Court:
- Implementing age-appropriate, culturally sensitive **sexuality education** in schools.
- Launching a **Child Marriage Free Village** initiative, similar to the Open Defecation Free Village program, involving local leaders.
- Establishing a designated portal for **online reporting of child marriages** through the Home Ministry.
- Initiating a **compensation scheme** for girls who **opt out** of child marriages through the Ministry of Women and Child Development.
- Allocating an annual budget to prevent child marriages and support affected individuals.
- Judicial Confusion on Personal Laws

Supreme Court Defends Regulatory Laws for Minority Institutions: No Violation of Secularism

Sub: Polity

Sec: Constitution

Why in News

The **Supreme Court of India,** while hearing a case concerning the **regulation of madrasas** under the **Uttar Pradesh Board of Madrasa Education Act, 2004,** clarified that laws regulating **religious or linguistic minority institutions** do not inherently breach **secularism.** This observation followed a challenge to an **Allahabad High Court decision,** which had struck down the Act, claiming it **violated secular principles.**

Supreme Court's Stand on Secularism and Minority Institutions:

The **Supreme Court** observed that regulating institutions run by **religious or linguistic minorities does not automatically breach secularism.**

Chief Justice of India (CJI) emphasized that a law regulating such institutions, by itself, does not violate the principle of secularism. He clarified that a **State has the right to regulate minority institutions, especially when they are government-aided.**

The CJI stressed that **providing broad-based education in madrasas** is essential for students to acquire knowledge beyond religious teachings and **become productive citizens.**

What is the definition of minority under Indian laws?

The expression **"minorities"** appears in some Articles of the Constitution, but is **not defined anywhere.**

In the exercise of its powers under the **Section 2(c) of the NCM Act,** the **Centre on October 23, 1993,** notified **five groups — Muslims, Christians, Sikhs, Buddhists and Parsis — as 'minority' communities. Jains were added to the list in January 2014.**

What does the Constitution say about minorities?

Article 29, which deals with the "**Protection of interests of minorities",** says that "any section of the citizens residing in the territory of India or any part thereof having a **distinct language, script or culture** of its own shall have **the right to conserve the same**", and that "**no citizen shall be denied admission into any educational institution** maintained by the State or receiving aid out of State funds **on grounds only of religion, race, caste, language or any of them**".

Article 30 deals with the "**right of minorities to establish and administer educational institutions**". It says that all minorities, whether **based on religion or language**, shall have the right to establish and administer educational institutions of their choice. It says that "in making any law providing for the compulsory acquisition of any property of an educational institution established and administered by a minority…, the State shall ensure that the amount fixed by or determined under such law for the acquisition of such property is such as would not restrict or abrogate the right guaranteed under that clause", and that "the state shall not, in granting aid to educational institutions, discriminate against any educational institution on the ground that it is under the management of a minority, whether based on religion or language".

Article 350(A) says there shall be a **Special Officer for linguistic minorities to be appointed by the President.** "It shall be the duty of the Special Officer to investigate all matters relating to the safeguards provided for linguistic minorities under this Constitution and report to the President upon those matters at such intervals as the President may direct, and the President shall cause all such reports to be laid before each House of Parliament, and sent to the Governments of the States concerned".

Article 28 - Prohibition of Religious Instruction in State-Funded Educational Institutions

Article 28 deals with the **issue of religious instruction in educational institutions,** especially those funded or maintained by the state. **It establishes clear boundaries between religion and education in India.**

Clause (1): **Prohibits religious instruction** in educational institutions **fully funded by the state.**

Clause (2): Institutions with **religious endowments** can provide religious instruction even if maintained by the state.

Clause (3): No student in **state-recognized or state-aided institutions** can be forced to participate in religious instruction or **worship without their consent.**

Promotes secularism by preventing religious teachings in government-funded institutions **while protecting individual freedom of religion in education.**

About SECULARISM:

Secularism is defined as a **separation of religious institutions** from the institutions of state, and **no domination** of the political sphere by religious institutions.

It is the belief that **religion should not influence** or be involved in the organization of society, education, government, etc.

The following are the features of Indian secularism:

1. **Equal respect** and regard for **all faiths** by the nation.
2. **No prejudice** sponsored by the state between residents on religion basis.
3. India follows the **policy of non-interference** in the functioning of any faith by the state.
4. Moreover, **the 42nd Constitutional Amendment of the Indian Constitution** states that India is a **secular country,** thus, there is **no relationship between religion and state.** However, India pays respects to all religions but **it did not recognize any national religion.**

Indian philosophy of secularism is related to "Sarva Dharma Sambhava" which means equal respect to all religions.

India **does partially** separate religion and state. For example, it **does not have an official** state religion and state-owned educational institutions cannot impart religious instructions.

Does madarsa education violate secularism? SC to decide

Sub: Polity

Sec: Constitution

Context:

The Allahabad High Court had, in March 2024, **struck down the Uttar Pradesh Board of Madarsa Education Act, 2004 (Madarsa Act)**.

The ruling was challenged in the Supreme Court, and the SC stayed the HC verdict until it decided the validity of the UP law. The case is still pending with the Supreme Court.

NCPCR Directive:

With the case pending, the **National Commission for the Protection of Child Rights** (NCPCR) issued two communications in June this year, directing the UP government to **investigate recognised madrasas and admit non-Muslim students to schools imparting formal education**.

It also requested the Centre to direct all states and Union Territories to **inspect madrasas and withdraw recognition** of those that were not compliant with the **Right to Education Act, 2009**.

Both notifications were stayed by the Supreme Court on October 21.

The Madarsa Act, 2004:

- The Act provides the **legal framework for madrasa education in Uttar Pradesh** where, apart from the curriculum of the National Council of Educational Research and Training (NCERT), religious education is imparted as well.
- Thus, it **integrates both religious and secular subjects**.
- It established the **Uttar Pradesh Board of Madarsa Education**, which oversees curriculum preparation, course material, and examination for various levels of madrasa education.

Key Statistics:

As of 2018-19, India had a total of 24,010 madrasas, with over 60% located in Uttar Pradesh.

Approximately 1.69 lakh students appeared for UP madrasa education board examinations equivalent to Class 10 and Class 12 in 2023.

Allahabad High Court's Decision:

On March 22, 2024, the Allahabad High Court **struck down the Madarsa Act** on **three primary grounds:**

Secularism: The court argued that the Act violated the principle of secularism by mandating religious education. The court held that the government has a duty to provide secular education, and **cannot discriminate** by providing **education based on religion**.

Right to Education: The HC held that the Act failed to provide quality education in modern subjects, thus **infringing upon Article 21A of the Constitution**, which guarantees the right to free and compulsory education for children aged six to fourteen.

Conflict with Central Law: It was determined that the Act's provisions conflicted with the University Grants Commission Act, 1956, which stipulates that only recognized universities can grant degrees and no other person or authority, including any Madarsa or the Madarsa Board, can confer any degree.

Religious Education vs. Religious Instruction:

- The Supreme Court previously distinguished between the two. Religious instruction, which includes mandatory attendance for worship, is not allowed in state-recognized institutions under Article 28.
- In contrast, religious education aims to promote understanding among different religions.
- Senior Advocate Menaka Guruswamy argued that the High Court mistakenly equated regulation with religious instruction, leading to a misunderstanding of secularism.
- **Impact of the case:**
- All educational institutions that impart some manner of religious education, such as **gurukuls and convent schools** will be affected by the decision of the Supreme Court on how the principles of secularism interact with the functioning of these institutions.

Justice Sanjiv Khanna Appointed as the 51st Chief Justice of India

Sub : Polity

Sec: Constitution

Why in News

Justice Sanjiv Khanna has been appointed as the next **Chief Justice of India (CJI)** and will assume office on **November 11, 2024**. The Union government has officially notified his appointment following the recommendation by the current **Chief Justice D.Y. Chandrachud,** who will retire on **November 10, 2024**.

Appointment of CJI:

Article 124 of the **Constitution of India** provides for the manner of **appointing judges to the Supreme Court (SC).** But there is no specific provision in the Constitution for appointing the Chief Justice.

CJI should be the senior most judge of the Supreme Court (SC). Law Minister has to seek recommendation of the outgoing CJI for appointment of new CJI at an appropriate time.

In case of doubt about the **fitness of the senior-most Judge to hold office of CJI** consultation with other Judges **under Article 124(2)** to be made.

Law Minister then puts up recommendation to Prime Minister (PM) who will advise the President on appointment.

Seniority at the apex court is determined not by age, but by the date a judge was appointed to the SC.

If two judges are elevated to the Supreme Court on the same day,

(1) the one who was sworn in first as a judge would trump another;

(2) if both were sworn in as judges on the same day, the one with more years of high court service would 'win' in the seniority stakes;

(3) an appointment from the bench would 'trump' in seniority an appointee from the bar.

<u>**Tenure:**</u>

Once appointed, the **Chief Justice remains in office** until the **age of 65 years.**

Article 124(4) of Constitution of India provides that a **SC Judge including CJI can be moved only through a process of impeachment by Parliament.**

<u>**Role and Functions of the Chief Justice of India:**</u>

- Presiding over the **Supreme Court** and leading judicial proceedings.
- Acting as the **administrative head** of the Supreme Court.
- Allocating cases and forming benches to ensure the **effective functioning of the court.**
- Overseeing the functioning of **subordinate and high courts** across India.

The CJI has the authority to take **Suo motu cognizance** (acting without a formal complaint) of matters that require **urgent judicial intervention.**

The CJI heads the **Collegium**, a body of **senior judges** responsible for the **appointment and transfer of judges** in higher judiciary. This system was established by various Supreme Court rulings and is **not explicitly mentioned in the Constitution.**

Justice K.S. Puttaswamy passes away

Sub : Polity

Sec : Constitution

Context:

Justice K.S. Puttaswamy, a former **Karnataka High Court judge** and the pivotal petitioner in India's landmark **'right to privacy'** case, passed away at 98.

Early Life and Career:

- **Born**: 1926 near Bengaluru.
- **Education**: Studied at Maharaja College, Mysuru, and Government Law College, Bengaluru.
- **Legal Career**: Enrolled as an advocate in 1952, practicing at the then-Mysore High Court (now Karnataka High Court).
- **Judicial Appointment**: Became a judge at the Karnataka High Court on November 28, 1977, and served until retirement in 1986.
- **Post-Retirement Roles**:
    o Appointed as the **first Vice-Chairman** of the **Bengaluru bench** of the **Central Administrative Tribunal.**
    o Served as **chairperson** of the **Andhra Pradesh Backward Classes Commission.**

Landmark 'Right to Privacy' Case:

- **Challenge to Aadhaar**: In **2012**, at the age of **86, Justice Puttaswamy** filed a petition challenging the **Aadhaar scheme**, raising concerns over its implications on individual privacy.
- **Supreme Court Decision**: His petition prompted the **Supreme Court** to examine whether **privacy is a fundamental right under the Indian Constitution.**
- **Historic Verdict**: In **August 2017,** the Supreme Court's nine-judge bench ruled unanimously in *Justice K.S. Puttaswamy (Retd.) v. Union of India* that **privacy is indeed a fundamental right.**
- **Triple Test: The judgment established that any invasion of privacy must satisfy three requirements:**
    o Legality (must be backed by law)
    o Necessity (legitimate state aim)
    o Proportionality (means should be proportional to the objective)

Reflections on the Verdict:

- **Justice Puttaswamy** welcomed the verdict, calling it **"correct and beneficial"** and noted that the **Supreme Court's decision** aligned with his expectations.
- He shared that his petition stemmed from concerns that Aadhaar was being implemented without Parliamentary debate, prompting him to act to protect citizens' rights.

This judgment is particularly significant as it:

- Modernized Indian privacy law for the digital age
- Protected individual rights against both state and private actors

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- Influenced the drafting of data protection legislation
- Established privacy as an essential component of human dignity

Who gets the preferred symbol when there are two factions?

Sub :Polity

Sec: Elections

Context:

- Sharad Pawar, founder of the Nationalist Congress Party (NCP), has filed a plea in the Supreme Court to prevent the Ajit Pawar faction from using the 'clock' symbol in the upcoming assembly elections in Maharashtra.

About NCP:

- The NCP is recognized as a **state party in Maharashtra and Nagaland**.
- The election symbol of NCP is an **analogue alarm clock.** The clock is drawn in blue and has two legs and an alarm button. It is situated on a tri-coloured Indian flag.

About the case:

- In July 2023, a split occurred within the NCP, with the Ajit Pawar faction claiming the support of 41 MLAs out of 53 in the Maharashtra assembly.
- In February 2024, the **ECI recognized the Ajit Pawar faction as the real NCP** and allotted it the clock symbol.
- The faction led by Sharad Pawar was given the common symbol of **man blowing turha.**
- The plea from **NCP (Sharad Pawar)** claims that during the Lok Sabha elections, voters experienced confusion regarding which faction truly represented the NCP, prompting them to seek **freezing of the clock symbol and allocating a new symbol for the Ajit Pawar faction**.

How are symbols allotted:

- The Election Commission of India (ECI) allocates symbols to political parties based on the **Symbols Order**.
- According to the Symbols Order, in the event of a split in a recognized political party, the **Election Commission of India** determines **which faction retains recognition** and allocates the reserved symbol to that group.

Symbol Freezing:

- The ECI has historically frozen party symbols in disputes, such as the **two leaves** symbol of **AIADMK** and the **bow and arrow** symbol of **Shiv Sena**, to resolve competing claims before determining the outcome of the dispute.

Criteria for Recognition of Factions:

- The **Supreme Court**, in the case of **Sadiq Ali versus ECI (1971),** established the **3-test formula** for determining which faction is to be recognised as the original political party.
    1. Aims and objectives of the party
    2. Adherence to the party's constitution that reflect inner party democracy
    3. Majority in the legislative and organisation wings.

ECI's February 2024 order:

- In its February 2024 ruling, the ECI found no dispute between the two factions of the NCP regarding the first test of legitimacy and deemed the second test unnecessary since neither faction adhered to the party constitution.
- Thus, ECI determined the issue **based solely on legislative majority**, siding with the Ajit Pawar faction, which had majority support.

Recent developments:

- In the recent Lok Sabha elections, the NCP (SP) faction won eight seats with its new symbol, compared to just one seat for Ajit Pawar's faction, which used the traditional clock symbol.
- The Supreme Court generally refrains from interfering in electoral processes as it comes under the **domain of Election Commission** of India (ECI). However, it may intervene under exceptional circumstances to ensure fair elections.
- Given the recent electoral performance of the NCP (SP) and the challenge against the ECI's recognition of the Ajit Pawar faction, the **Supreme Court may consider directing the ECI to freeze the clock symbol for the upcoming assembly elections**.

Examining the Rising Costs of Elections in India and Potential Reforms

Sub :Polity

Sec: Elections

Why in News

The soaring costs associated with elections have become a subject of concern globally and in India. The **Centre for Media Studies (CMS)** recently estimated that the **expenses incurred by political parties during the 2024 Indian general election reached around ₹1,00,000 crore.** With countries like the **United States and the United Kingdom also witnessing high election expenditures, there is growing debate on managing costs and curbing unethical practices in the electoral process.**

Expenditure Limit:

It is the **amount an election candidate can legally** spend for their election campaign and has to account for, which includes expenses on public meetings, rallies, advertisements, posters, banners vehicles and advertisements.

The **limit prescribed by the ECI** is meant for legitimate expenditure because a lot of money in elections is spent for illegitimate purposes.

It has often been argued that these limits are unrealistic as the actual expenditure incurred by the candidate is much higher.

Current Scenario:

At present, under **Rule 90 of the Conduct of Election Rules, 1961**.

Candidate Limits: In India, election expenditure **limits for candidates are capped by the Election Commission of India (ECI).** These limits vary based on constituency size:

- **Lok Sabha Constituencies**: ₹95 lakh in larger states, ₹75 lakh in smaller states.
- **Legislative Assemblies**: ₹40 lakh for larger states, ₹28 lakh for smaller states.

Political Party Spending: Currently, there are **no expenditure limits for political parties during elections,** which has led to substantial **unregulated spending.**

Under **Section 77 of the Representation of the People Act, 1951**, **every candidate shall keep a separate and correct accou**nt of all expenditure incurred between the date on which he has been nominated and the date of declaration of the result.

All candidates are required to **submit their expenditure statement to the ECI within 30 days of the completion of the elections**.

An **incorrect account or expenditure** beyond the cap can lead to **disqualification** of the candidate by the ECI for up to three years, **under Section 10A of the Representation of the People Act, 1951.**

It can be noted that there is **no cap on a political party's expenditure**, which is often exploited by candidates of the party.

However, **all registered political parties** have to submit a **statement of their election expenditure to the ECI within 90 days** of the completion of the elections.

International Standards for Election Financing:

United States: The estimated expenditure for the upcoming **U.S. presidential and congressional elections is around $16 billion,** with $5.5 billion allocated for the presidential race and $10.5 billion for congressional elections.

United Kingdom: Political parties in the **U.K. can spend up to £54,010 per contested constituency, totalling a maximum of £35 million** if contesting all constituencies.

Key Challenges of Rising Election Expenditures:

Impact on Democratic Integrity: High election costs often drive a **dependency on large donations** from organizations and individuals, fostering a relationship between elected officials and major donors. This creates a barrier for average citizens seeking to enter politics, **potentially skewing representation.**

Excessive Spending in India: Despite **legal expenditure limits, candidates frequently surpass these caps,** while **political parties operate without spending restrictions.** Around 35% of expenses were directed toward campaigns and publicity, with an estimated 25% reportedly distributed illegally to voters.

Corruption Cycle: Inflated election spending contributes to **corruption, as candidates often seek returns on their investment, creating a cycle where political financing drives governance decisions.**

Reforms to Address Election Costs

Indrajit Gupta Committee (1998) and **Law Commission Report (1999)**: Both reports proposed **state funding for elections,** wherein the government would subsidize election expenses for candidates nominated by recognized political parties. Although promising, this proposal faces challenges in terms of feasibility and implementation.

Simultaneous Elections: Conducting **simultaneous elections is viewed as a potential solution to curbing costs.** However, it raises concerns related to federalism and would require significant constitutional amendments.

Practical Reforms Based on ECI's Recommendations

The **Election Commission's 2016 report on "Proposed Electoral Reforms"** suggests practical steps for equitable election expenditure:

1. **Candidate Funding Limitations**: Amend the law to include **"financial assistance"** from political parties within the **candidate's expenditure limit.**
2. **Cap on Political Party Expenditure**: Set a cap on **political party expenditures,** calculated as the candidate's expenditure limit multiplied by the number of candidates fielded by the party.

3. **Judicial Oversight**: Appoint **additional judges in High Courts for speedy resolution of election-related cases** to act as a deterrent against electoral malpractices.

Deadline Set for Nagaland Government's Response on Creation of Frontier Nagaland Territory

Sub : Polity

Sec: Federalism

Why in News

The **Eastern Nagaland People's Organisation (ENPO)** has issued an October 31, 2024, deadline for the **Nagaland government** to provide feedback to the **Ministry of Home Affairs** on the proposal for creating an **autonomous territory named Frontier Nagaland Territory (FNT).** This move could significantly impact the governance and territorial arrangement of Nagaland, specifically the six eastern districts bordering Myanmar.

What is Frontier Nagaland Territory?

The proposed FNT would comprise six districts: **Kiphire, Longleng, Mon, Noklak, Shamator, and Tuensang.**

The ENPO represents seven tribes: **Konyak**, **Phom**, **Sangtam**, **Yimkhiung**, **Chang**, **Tikhir** and **Khiamniungan,** has led the demand for the creation of FNT, citing long-standing neglect by the Nagaland state government towards these districts.

These districts make up **about 20 out of 60 seats** in the Nagaland Legislative Assembly and are located along the **India-Myanmar border**, making them strategically significant.

The ENPO claims that the eastern districts have been systematically neglected in terms of **infrastructure**, **education**, and **development**, which has prompted their call for greater political and administrative autonomy.

Historical Background: The demand for FNT was first articulated in **2010** by the ENPO, citing long-standing neglect by the state government in terms of **infrastructure**, **education**, and **healthcare** services in these regions.

The demand gained momentum in **2023**, when people from these districts **boycotted Nagaland's Statehood Day** and the **Hornbill Festival**—a major cultural event showcasing Naga heritage.

Constitutional Provisions:

Article 371A (Special Status for Nagaland): Nagaland enjoys **special provisions under Article 371A** of the Indian Constitution. This article ensures that **no Act of Parliament in respect of religious or social practices of the Nagas, their customary laws, ownership of land, and its resources, applies to the state unless the Legislative Assembly of Nagaland passes a resolution to do so.** This gives Nagaland significant autonomy over cultural and legal matters.

The **Sixth Schedule of the Constitution** of India allows for the formation of autonomous administrative divisions which have been given **autonomy within their respective states**.

Most of these autonomous district councils are located in **North East** India but **two are in Ladakh,** a region administered by India as a union territory.

Presently, 10 Autonomous Councils in **Assam, Meghalaya, Mizoram and Tripura** are formed by virtue of the Sixth Schedule with the rest being formed as a result of other legislation.

The **governor is empowered** to organise and re-organise the autonomous districts. Thus, he can increase or decrease their areas or change their names or define their boundaries and so on.

If there are different tribes in an autonomous district, the governor can divide the district into several autonomous regions.

Each autonomous district has a **district council consisting of 30 members**, of whom **four are nominated by the governor** and the remaining **26 are elected on the basis of adult franchise**.

The elected members hold office for a **term of five years** (unless the council is dissolved earlier) and nominated members hold office during the pleasure of the governor.

Each autonomous region also has a **separate regional council**.

The district and regional councils administer the areas under their jurisdiction. They can make laws on certain specified matters like land, forests, canal water, shifting cultivation, village administration, inheritance of property, marriage and divorce, social customs and so on.

But **all such laws require the assent of the governor**.

The district and regional councils within their territorial jurisdictions can constitute **village councils** or **courts for trial of suits** and cases between the tribes. They hear appeals from them.

The **jurisdiction of high court** over these suits and cases is **specified by the governor.**

The district council can establish, construct or manage primary schools, dispensaries, markets, ferries, fisheries, roads and so on in the district. It can also make regulations for the control of money lending and trading by non-tribals. But such regulations require the assent of the governor.

The district and regional councils are **empowered to assess and collect land revenue** and to impose certain specified taxes.

The **acts of Parliament or the state legislature do not apply** to autonomous districts and autonomous regions or apply with specified modifications and exceptions.

Supreme Court Upholds State's Power to Regulate Industrial Alcohol

Sub : Polity

Sec: Federalism

Why in News

The **Supreme Court of India,** in a landmark ruling, upheld the authority of **State legislatures** to **regulate industrial alcohol.** A **Constitution Bench** comprising **nine judges** delivered this judgment, which has significant implications for the **federal structure of governance in India,** especially regarding the **regulation of industrial and potable alcohol.**

Majority Judgment by the Supreme Court:

An **8:1 majority judgment** was delivered by a Constitution Bench.

Chief Justice, authoring the majority opinion, held that **industrial alcohol** falls under the category of **"intoxicating liquor"** as defined in **Entry 8 of the State List** under the **Seventh Schedule** of the **Indian Constitution.**

This ruling confirms that **States have the authority** to **regulate the production, possession, transport, and sale of industrial alcohol**.

Entry 8 of the State List:

- **Entry 8 gives States** the **power to regulate** the **production and sale** of **intoxicating liquor**.
- The Supreme Court interpreted **"intoxicating liquor"** to include industrial alcohol that can be used in products like **rectified spirit**, **extra neutral alcohol (ENA)**, and **denatured spirit**, all of which are raw materials for the production of potable alcohol.
- The Court held that this broad definition helps prevent the misuse of alcohol that could harm **public health**.
- **Subject Matter of Entry 8 of the State List**: Pertains to the **production, manufacture, possession, transport, purchase, and sale of intoxicating liquor.** States have the authority to **regulate intoxicating liquors** within their jurisdiction.
- Includes both **potable alcohol and alcohol that could be used noxiously,** such as industrial alcohol and rectified spirit.

Entry 52 of the Union List:

- Grants the **Union exclusive legislative power** over **industries** declared by law to be under its control.
- The **Parliament** must declare by law that Union control is **necessary for public interest.** Once declared, Union control **overrides the State's power to legislate under Entry 24.**
- Generally, applies to **industries of significant national importance,** requiring uniform regulation across the country.
- The **Centre** had argued that it holds exclusive control over industrial alcohol based on **Entry 52 of the Union List**, which refers to industries regulated in public interest by Parliament.
- The Court clarified that **Entry 52 of the Union List** cannot override **Entry 8 of the State List**.
- The **Union government** claimed that **regulating industrial alcohol was essential for national interests and public policy.** The judgment stated that **Parliament could not claim control over the entire alcohol industry by invoking Entry 52.**

Seventh Schedule of the Indian Constitution

- **Article 246** stands as the architect of the **7th Schedule**, outlining the Union List, State List, and Concurrent List.
- The **Union List,** comprising 100 subjects, vests **exclusive legislative authority in the Parliament**.
- The **State List**, encompassing 61 subjects, confers power upon **state legislatures for independent decision-making.**
- The **Concurrent List**, housing 52 subjects, illustrates the **shared jurisdiction between the Center and the States.**

Food safety laws in states

Sub : Polity

Sec: Legislation in news

Why in news?

- The UP government last week made it mandatory for food establishments to **"prominently" display** to customers the names of the **operator, proprietor, manager, and other relevant personnel**. The reason cited for the measure was to ensure public health.
- A day later, Himachal Pradesh minister said that in his state too, every eatery and fast-food cart will have to display the owner's ID. However, the statement was retracted later.

Supreme Court ruling:

- On July 22, the Supreme Court **stayed similar orders passed by police in UP and Uttarakhand** for this year's **Kanwar yatra**.

- The court said that the **competent authority** under the **Food Safety and Standards Act, 2006** (FSSA) could indeed issue such orders, but **police could not usurp this power.**

What are the regulations for selling food in India?

- Anyone who intends to operate a food business is **required to either register or license** their business from the Food Safety and Standards Authority of India (FSSAI).
- Under **Section 63 of the FSSA**, any operator carrying on a food business **without a licence** can be punished with **up to six months in prison and a fine of up to Rs 5 lakh**.

Under the **Food Safety and Standards (Licensing and Registration of Food Businesses) Rules, 2011**, enacted under the FSSA:

- **Petty Food Manufacturers** such as **small-scale food businesses, hawkers, vendors, and stall holders**, are required to register with the FSSAI.
- If the registration is approved, they receive a registration certificate and a photo identity card which shall be **displayed at a prominent place at all times within the premises or vehicle or cart.**
- Operators of **relatively large businesses** have to obtain a licence from the food authority. The licence must be displayed **at a prominent place at all times within the premises where the Food Business Operator carries on the food business**.
- In both cases, the owner's identity and the establishment's location are already required to be displayed through the photo ID and the licence.

Do states have the power to make rules under the FSSA?

- **Section 94(1) of the FSSA** says that the State Government can create rules, but only after getting **approval from the Central Government and the Food Authority**.
- They must also publish these rules beforehand.

Powers of State Government under FSSA:

- The state government **appoints the Commissioner of Food Safety under Section 30** to effectively implement the FSSA and its rules.
- **Sections 30(2)(a) to (e)** outline specific tasks for the Commissioner, such as conducting surveys, providing training, and approving legal actions for violations.
- **Section 30(2)(f)** allows the Commissioner to take on **additional tasks** as decided by the state government in consultation with the Food Authority.
- **Section 94(2)(c)** lets the state government create rules for any other necessary matters.
- **Section 94(3)** requires that these rules be presented to the state legislature for approval as soon as possible.

Can a state government's directives under FSSA be challenged in court?

- State government directives under the FSSA can be challenged in court.
- In previous case from UP and Uttarakhand, petitioners argued that the directives compelled individuals to **disclose their religious and caste identities**, **violating Article 15(1)** of the Constitution, which prohibits discrimination based on religion, race, caste, or sex.
- They claimed the orders could lead to **economic boycott of Muslim minorities**, infringing on the **right to practice any profession under Article 19(1)(g)** and promoting untouchability, contrary to Article 17.

Non-compliance with FSSA:

- If a Food Business Operator violates any provision of the FSSA, the food authority can issue an **Improvement notice** under Section 31, outlining the reasons for non-compliance, required corrective actions, and a minimum compliance period of 14 days.
- Failure to comply with the notice may result in license suspension or cancellation for repeat offenders.
- **Penalty:** Section 58 allows for fines up to ₹2 lakh for violations. A second conviction may double the penalty and incur additional daily fines up to ₹1 lakh.

Food Safety and Standards Authority of India (FSSAI):

- FSSAI is a body established under the **Food Safety and Standards Act, 2006** to monitor and create regulations for how food should be **processed, distributed, sold, and imported** to ensure **safe and wholesome**

Most ICCs in entertainment industry not legal: women's commission to HC

Sub :Polity

Sec: Legislation in news

Context:

- The Kerala Women's Commission informed the High Court that many Internal Complaints Committees (ICC) formed within the entertainment industry are **not legally constituted** as per **Section 4 of the POSH Act**.
- The matter came up during hearings of public interest litigations following the **Hema Committee report**, which highlighted issues related to women's safety and workplace harassment.

Legal provision:
- **Section 26(1)(a) of the POSH Act** makes it an **offense to fail in constituting an ICC** as mandated in **Section 4(1).**

Need for amendment:
- The women's commission pointed out that the current **POSH Rules do not specify who is authorized to file complaints** regarding violations under Section 26(1).
- It also urged the Centre to amend the POSH Rules to align with the POSH Act for effective implementation.

Suggestions to celebrities:
- The High Court Bench advised actors and celebrities to avoid roles that portray women derogatorily, emphasizing their social responsibility.
- The suggestion stemmed from concerns that negative portrayals could influence public perception and behaviour regarding women's conduct.

POSH Act:
- The Sexual Harassment of Women at Workplace (Prevention, Prohibition, and Redressal) Act, often known as the PoSH Act, was passed in 2013.
- The Act defines sexual harassment as any unwelcome act or behaviour (whether directly or by implication) such as;
    - Physical contact and advances
    - A demand or request for sexual favours
    - Making sexually coloured remarks
    - Showing pornography
    - Any other unwelcome physical, verbal or non-verbal conduct of sexual nature.
- The Act provides a mechanism for the prevention, prohibition, and redressal of complaints of sexual harassment in the workplace.

Key Provisions:
- The Act **covers both organised and unorganised sectors**, and **applies to all women**, irrespective of their age or employment status.
- Domestic workers, students, research scholars, patients, customers, clients, and tourists are also included.
- Offices, factories, stores, hotels, restaurants, educational institutions, hospitals, sports facilities, transportation services, entertainment venues, and houses are all covered by the Act.

Internal Complaints Committee (ICC)
- Every employer is required to constitute an **Internal Complaints Committee (ICC) at each office or branch with 10 or more employees.**
- At **least one-half of the members of the ICC should be women.**
- The ICC is made up of **a presiding officer** (a senior woman employee), **two other workers (**ideally committed to women's rights), and **one external member** (from an NGO or legal background).
- The ICC is in charge of receiving and investigating complaints of sexual harassment from female employees and proposing appropriate action to the employer.

Local Complaints Committee (LCC):
- The Act also provides for the **constitution of a Local Complaints Committee (LCC) by the District Office**r for cases where the **complaint is against the employer or where the workplace has less than 10 workers.**
- According to law, a **Company having more than 10 employees is mandated to constitute an Internal Complaints Committee (ICC).**
- For a **company having less than 10 employees, it is not mandatory to have ICC**.
- Any woman who has been subjected to sexual harassment at the workplace can file a complaint within 3 months of the incident or series of incidents to the ICC or LCC, as applicable.
- The LCC has the same powers and functions as the ICC.

Investigation and Action:
- The ICC or LCC is required to **complete the inquiry into the complaint within 90 days** and submit a report with its recommendations to the employer or district officer.

- The **employer or district officer is required to take action on the recommendations of the ICC or LCC within 60 days** and inform the complainant and respondent about it.

Protection against false Complaints:

- The Act provides for penalties for false or malicious complaints, non-compliance with the provisions of the Act by the employer or ICC or LCC members, and victimization or retaliation against the complainant or witness.

Wayanad Landslide Relief: Kerala High Court Seeks Centre's Response on Delay in Funds

Sub : Polity

Sec: Msc

Why in News

The **Kerala High Court (HC)** has sought a response from the **central government** regarding the delay in releasing relief funds from the **National Disaster Response Fund (NDRF)** and the **Prime Minister's National Relief Fund (PMNRF)** for victims of the **Wayanad landslide.**

National Disaster Response Fund:

Defined under **sec 46 of Disaster Management Act, 2005 (DM Act).**

It is a fund **managed by the Central Government** for meeting the expenses for emergency response, relief and rehabilitation due to any threatening disaster situation or disaster.

Located in the "**Public Accounts**" of Government of India under "Reserve Funds not bearing interest".

Comptroller and Auditor General of India (CAG) audits the accounts of NDRF.

Constituted to supplement the funds of the State Disaster Response Funds (SDRF) of the states to facilitate immediate relief in case of calamities of a severe nature.

National Calamity Contingency Fund (NCCF) was renamed as **National Disaster Response Fund (NDRF)** with the enactment of the Disaster Management Act in 2005.

What is it to be used for?

NDRF amount can be **spent only towards meeting the expenses for emergency response, relief and rehabilitation**. For projects exclusively for the purpose of mitigation, i.e, measures aimed at reducing the risk, impact or effect of a disaster or threatening disaster situation a separate fund called National Disaster Mitigation Fund has to be constituted.

Sources of Financing NDRF:

Financed through the **levy of a cess on certain items,** chargeable to excise and customs duty, and approved annually through the Finance Bill.

The requirement for funds beyond what is available under the NDRF is met through **general budgetary resources.**

Currently, a **National Calamity Contingency Duty (NCCD)** is levied to finance the NDRF and additional budgetary support is provided as and when necessary. A provision also exists in the **DM Act**,2005 to encourage any person or institution to make a contribution to the NDRF.

Prime Minister's National Relief Fund (PMNRF)

The **Prime Minister's National Relief Fund (PMNRF)** was established in **1948 by Prime Minister Jawaharlal Nehru** to provide assistance to displaced persons following the partition of India. Over the years, the fund's scope has expanded to support victims of **both natural and man-made disasters.**

The PMNRF is primarily used to offer relief to those affected by:

Natural disasters: Floods, cyclones, earthquakes, etc.

Man-made disasters: Major accidents, acid attacks, riots, and other crises.

Funding and Administration

The fund is made up entirely of **public contributions** and **does not receive any government budgetary allocations.**

The **corpus** is invested in fixed deposits with banks, and disbursements are made only with the **Prime Minister's approval**.

Donations to the PMNRF are eligible for **100% tax deduction** under **Section 80G of the Income Tax Act, 1961**.

The next Census

Sub : Polity

Sec: Msc

Context:

- The Centre is set to conduct the Census, which was **postponed in 2021 due to COVID-19**. While an official announcement is awaited, sources indicate it may begin next year.
- The Census is crucial for delimiting Parliamentary constituencies and implementing women's reservation in Parliament.

- The **128th Constitution Amendment reserves 33% of seats for women** but will only take effect after delimitation.

About Census:
- The census provides information on size, distribution and socio-economic, demographic and other characteristics of the country's population.
- The Census is listed as **item 69 on the Union List**, meaning only the Central government can conduct it.
- The **Census of India Act of 1948** provides a legal basis but lacks stipulations on timing or periodicity. There is **no constitutional or legal mandate** for conducting a Census every 10 years.
- A systematic and modern population census was conducted between 1865 and 1872 in different parts of the country.
- However, the **first synchronous census in India was held in 1881**. Since then, censuses have been undertaken uninterruptedly once every ten years.
- 2021 was the first year since 1881 that the decennial Census was not conducted.

Process of conducting Census:
- **Two-step process:**
    - **House-listing and Numbering:** Conducted the year before the Census (April-September).
    - **Population Enumeration:** Takes place in the second to fourth weeks of February in the Census year.
- The numbers revealed represent the **population of India as of midnight on March 1** in the Census year.
- To account for the births and deaths during the enumeration period in February, the enumerators return to the households in the first week of March to make revisions.

Census and Delimitation:
- Delimitation, as mandated by the constitution, is supposed to happen after every Census.
- The process adjusts the number of constituencies of Parliament and state Assemblies in accordance with the latest population figures, to ensure that the number of people represented by any Member of Parliament or Member of Legislative Assembly is roughly the same.

Suspension of Delimitation:
- Delimitation exercise has been suspended since 1976 so that states' family planning programs would not affect their political representation in the Lok Sabha.
- As of now, delimitation is **suspended till at least 2026.** According to the **84th Constitutional Amendment** of 2001, the next delimitation can be held only based on the Census conducted after 2026.
- Even if the 2021 Census had occurred on time, delimitation could only take place after the 2031 Census. However, if the Census, which takes two years to complete, starts next year, delimitation could occur immediately afterward.
- Southern states, which have succeeded in population control, fear losing representation if delimitation is based on current data. Previous delimitation in 2002 only modified existing constituency boundaries without changing their numbers.

Caste Census:
- There are calls for the upcoming Census to include caste data, potentially reducing the need for a separate caste census. Caste data collection was last conducted in 1941 and discontinued post-1951, focusing instead on Scheduled Castes and Tribes.

CAG Urges Advancing Date for Closure of States' Monthly Accounts
Sub :POLITY

Sec: National body
- **Call for Advancing Monthly Account Finalization**:
    - **CAG Murmu** emphasized the need to **advance the finalization** of states' monthly accounts to the **10th of the succeeding month** instead of the **current deadline of the 25th**.
    - He made this statement during the **first State Finance Secretaries Conference**, organized by the **Comptroller and Auditor General (CAG) of India**.
- **Need for Harmonization of Expenditure**:
    - **Harmonization of expenditure** at the **disaggregate level of 'Object Heads'** for all State governments and the Centre was highlighted as a key area needing attention.
    - This matter has been a point of concern for **multiple stakeholders** for some time.
- **Engagement with Stakeholders**:
    - The CAG stressed that it is crucial to **engage with stakeholders**, especially the **Union and State governments**, to make **public financial management** more **robust and sustainable**.

- **Financial Management Reforms**:
  - o **Reforms in financial management applications** like the **Central PFMS**, **State IFMS**, and **RBI's e-Kuber** should interface with the CAG's accounting applications in states.
  - o This would ensure **robust and timely reporting** across states.
- **Annual Conference on Public Financial Management**:
  - o **Deputy CAG (Government Accounts) Jayant Sinha** announced that the conference will become an **annual event** in the fiscal calendar to **engage with State governments** and stakeholders on issues of **public financial management**.
- **Participants in the Conference**:
  - o The conference was attended by the **Secretary (Expenditure)**, Government of India, and senior officials like **Additional Chief Secretaries, Principal Secretaries, Secretaries (Finance)** from various states.
  - o Representatives from the **RBI**, **constituted accounting services**, and the **Union Ministry of Finance** also participated.

This summary captures the main points of the conference, highlighting the **importance of advancing monthly account finalization**, **harmonizing expenditure**, and ensuring **stakeholder engagement** for improved **public financial management**.

Central PFMS (Public Financial Management System):

PFMS is an online platform developed by the **Controller General of Accounts (CGA)** under the Ministry of Finance, Government of India. It **facilitates efficient management of government funds by providing real-time information on fund disbursement and expenditure**. The platform aims to improve transparency, accountability, and financial discipline in the government's payment systems. PFMS is used extensively for tracking payments under various government schemes, subsidies, grants, and more. It helps in ensuring that funds are utilized for the intended purpose.

State IFMS (Integrated Financial Management System):

State-level IFMS platforms are implemented by individual state governments to manage their public finances. These systems integrate various functions such as **budgeting, treasury, accounting**, and **payroll**, and allow seamless communication between different state departments and financial entities.

State governments use IFMS to improve financial discipline, ensure timely payments (such as salaries and pensions), and enhance transparency in the use of public funds.

RBI's e-Kuber:

The **e-Kuber** platform is a **Core Banking Solution** (CBS) for the **Reserve Bank of India (RBI)**, facilitating banking transactions for the government and other financial institutions. **It allows real-time processing and settlement of government payments, receipts, and transactions.**

e-Kuber helps **manage liquidity and monetary transactions between the RBI, commercial banks, and the government.** It enables the smooth functioning of government payments such as subsidies, salary disbursements, and tax collections.

CCPA Issues Show-Cause Notice to Ola Electric for Alleged Consumer Rights Violations

Sub :POLITY

Sec: National body

Show-Cause Notice from CCPA:

- The **Central Consumer Protection Authority (CCPA)** issued a **show-cause notice** to **Ola Electric Mobility Ltd.**.
- The notice pertains to alleged **violations of consumer rights**, **misleading advertisements**, and **unfair trade practices**.
- **Timeline for Response**:
  - o Ola Electric has been given **15 days** to respond to the notice.
  - o The company confirmed it will respond within the stipulated time, providing the necessary **supporting documents**.
- **Impact on Stock**:
  - o On Monday, **Ola Electric's stock** experienced a drop of **over 8%**.
  - o However, on Tuesday, the stock recovered by **5.11%** to ₹95.46.
  - o Despite this recovery, analysts predict that **challenging times** may lie ahead for Ola Electric.

In summary, **Ola Electric** is facing regulatory scrutiny from the **CCPA** for alleged unfair practices, and while its stock has shown some recovery, the **competitive landscape** in the EV market continues to pose challenges.

Central Consumer Protection Authority (CCPA)

Establishment:

- **Year of Establishment**: 2020

- **Based on**: Provisions of the **Consumer Protection Act, 2019**.
- **Nodal Ministry**: Ministry of Consumer Affairs.

Composition:
- **Head**: A **Chief Commissioner**.
- **Members**:
- Two **Commissioners**:
- One handles matters related to **goods**.
- The other handles matters related to **services**.
- **Investigation Wing**:
  - Led by a **Director General** to conduct investigations.

Powers and Responsibilities:
- **Primary Objective**:
  - To promote, protect, and enforce the **rights of consumers** as a class.
- **Empowered to**:
  - **Conduct Investigations**: Look into violations of consumer rights and take appropriate legal action.
  - **Order Recall**: Recalling unsafe goods and services from the market.
  - **Discontinue Unfair Practices**: Take action against misleading advertisements and unfair trade practices.
  - **Impose Penalties**: Penalize manufacturers, advertisers, endorsers, and publishers involved in deceptive practices.

District Collectors' Powers:
- **Investigate Complaints**:
  - Violations of consumer rights.
  - Unfair trade practices.
  - False or misleading advertisements.

Enforcement Actions:
- **Investigations**: Probe violations of consumer rights.
- **Prosecutions**: File complaints against violators.
- **Order Recalls**: Unsafe goods and services can be withdrawn from the market.
- **Stop Unfair Practices**: Tackle misleading advertisements and unfair practices.
- **Penalties**: Enforce penalties on offenders, including advertisers.

Consumer Protection Focus:
- The **CCPA** ensures the **protection of consumer rights** by maintaining a **fair and transparent marketplace**.
- The authority plays a **regulatory role** by ensuring compliance with consumer protection laws and fostering awareness about consumer rights.

Regulatory Role:
- Acts as a **regulatory body** ensuring that businesses adhere to consumer protection laws.
- Ensures that the rights of consumers are respected and market practices remain transparent.

Vijaya Kishore Rahatkar to be new NCW chairperson
Sub :Polity

SEC: National body

Context:
- Vijaya Kishore Rahatkar has been appointed the **ninth Chairperson** of the National Commission for Women (NCW). The appointment was made under **Section 3 of the National Commission for Women Act**, 1990.

About National Commission for Women (NCW):
- The NCW, a **statutory body**, was set up in January 1992 under the **National Commission for Women Act, 1990.**
- Its mission is to strive towards enabling women to achieve **equality and equal participation** in **all spheres of life** by securing her due rights and entitlements through suitable policy formulation, legislative measures, etc.

Functions:
- Review the constitutional and legal safeguards for women.

- Recommend remedial legislative measures.
- Facilitate redressal of grievances.
- Advise the Government on all policy matters affecting women.

Composition:
- The National Commission for Women (NCW) is made up of a **chairperson, a member secretary, and five members nominated by the central government**.
- **Five members:**
  - One member from the Scheduled Castes
  - One member from the Scheduled Tribes
  - One member from the minority communities
  - Two other members chosen based on their expertise in areas related to women's issues, such as law, education, health, or social work.

Term of office:
- The Chairperson and members hold office for a period of three years or until they reach the age of 65, whichever comes first. They are eligible for reappointment.

Removal:
The **Central Government** may by order remove the Chairperson or any other Member from office in the following cases:
- Is adjudged insolvent.
- Engages during his term of office in any paid employment outside the duties of his office.
- Refuses to act or becomes incapable of acting.
- Is of unsound mind and stands so declared by a competent court.
- Has so abused his office as to render his continuance in office detrimental to the public interest.
- Is convicted and sentenced to imprisonment for an offense which in the opinion of the Central Government, involves moral turpitude.

20 bomb threats in a day; security regulator meets CEOs of airlines
Sub : POLITY

SEC: National Body

Context:
- In the wake of 20 bomb threats to various airlines in a day and six consecutive days of bomb threats, the **Bureau of Civil Aviation Security (BCAS)** convened a meeting with the CEOs of major airlines to address the escalating situation.
- The primary aim of the meeting was to strike a balance between ensuring **aviation security** and minimizing **passenger inconvenience**.

About Bureau of Civil Aviation Security (BCAS):
- The Bureau of Civil Aviation Security (BCAS) is the regulatory authority responsible for ensuring the security of civil aviation in India.
- Initially set up as a Cell in the Directorate General of Civil Aviation (DGCA) in 1978 on the recommendation of the **Pande Committee**, BCAS was reorganized into an **independent department** under the **Ministry of Civil Aviation** in 1987.
- BCAS Headquarters is located in New Delhi. It has four Regional Offices located at international airports in Delhi, Mumbai, Kolkata and Chennai.

Functions:
- Laying down Aviation Security Standards in accordance with **Annex 17 to Chicago Convention.**
- Monitoring the implementation of security rules and regulations.
- Ensure that personnel implementing security controls are properly trained and possess the necessary competencies to fulfil their responsibilities.
- Planning and coordination of Aviation security matters.
- Surprise/Dummy checks to test professional efficiency and alertness of security staff.

Schemes

Government Initiatives in Agriculture and Energy: New Mergers and Mission for Growth

Sub: Schemes

Sec: Agri

Why in News

The Union Cabinet, announced significant reforms in the agriculture sector, **merging multiple schemes under two umbrella initiatives.** It also launched the **National Mission on Edible Oils - Oilseeds (NMEO-Oilseeds)** to boost domestic oilseed production and enhance energy efficiency initiatives.

Merging of Central Schemes into Two Major Initiatives

The Union Cabinet has decided to consolidate all Central schemes related to agriculture under two flagship programs:

Pradhan Mantri Rashtriya Krishi Vikas Yojana (PM-RKVY)

Krishonnati Yojana (KY)

The total projected expenditure for these schemes is **₹1,01,321.61 crore**, with a **Central share of ₹69,088.98 crore** and the remaining **₹32,232.63 crore** being contributed by States.

Pradhan Mantri Rashtriya Krishi Vikas Yojana (PM-RKVY): It is an umbrella scheme aimed at promoting sustainable agriculture in India.

The Union Cabinet has allocated **a budget of ₹1,01,321.61 crore for this scheme,** which is implemented by state governments with significant flexibility to adjust funds based on local needs.

The key components of **PM-RKVY** include:

Soil Health Management: Focuses on improving soil health and fertility.

Rainfed Area Development: Supports farming in rainfed regions, promoting sustainable and climate-resilient agricultural practices.

Agro Forestry: Encourages tree-based farming systems to enhance income and environmental benefits.

Paramparagat Krishi Vikas Yojana: Promotes organic farming practices across the country.

Agricultural Mechanization including Crop Residue Management: Aims to mechanize farming practices and manage crop residue to reduce pollution, especially in states like Punjab and Haryana.

Per Drop More Crop: Focuses on water use efficiency through micro-irrigation techniques.

Crop Diversification Programme: Encourages farmers to shift from water-intensive crops to more sustainable alternatives.

RKVY DPR Component: A newly introduced component, providing flexibility to prepare Detailed Project Reports (DPR) for agricultural programs.

Accelerator Fund for Agri Startups: Supports innovation and startups in the agriculture sector, providing funds for research and development.

Krishonnati Yojana (KY): The Yojana now integrates multiple schemes to **avoid duplication** and ensure better **resource utilization**. States have more flexibility in fund allocation, allowing them to address specific agricultural challenges like climate resilience and food security.

The total fund for KY is ₹44,246.89 crore, with a major portion funded by the central government.

The scheme emphasizes **organic farming** in the North-Eastern region, expanding the **Mission Organic Value Chain Development**.

State-Level Planning: Annual Action Plans (AAP) streamline planning, providing quicker approval for state-specific agriculture initiatives.

National Mission on Edible Oils (NMEO-Oilseeds): The mission aims to enhance domestic oilseed production and reduce reliance on imports of edible oils.

Implemented over **7 years (2024-31)** with a **financial outlay of ₹10,103 crore**.

Focus on **Rapeseed-Mustard, Groundnut, Soybean, Sunflower, Sesamum**, along with increasing oil extraction from **Cottonseed, Rice Bran, and Tree-Borne Oils (TBOs)**.

Increase **primary oilseed production from 39 million tonnes (2022-23) to 69.7 million tonnes by 2030-31** and **edible oil production to 25.45 million tonnes**.

Use of **high-yielding seed varieties, genome editing**, and promoting oilseed cultivation on **fallow lands** (rice, potato) and through **intercropping**.

Establish **65 seed hubs** and **50 seed storage units**, and introduce an online 5-year rolling seed plan via the **SATHI Portal** for quality seed availability.

Develop **600+ clusters** across 347 districts, managed by **FPOs, cooperatives**, and private entities, covering over 10 lakh hectares annually.

International Energy Efficiency Hub: India has recently signed a letter of intent to join the **International Energy Efficiency Hub**, enhancing its commitment to global energy efficiency efforts and reducing greenhouse gas emissions.

The Hub, established in 2020 as a successor to the International Partnership for Energy Efficiency Cooperation (IPEEC), is a collaborative platform that includes **16 member countries**: Argentina, Australia, Brazil, Canada, China, Denmark, the European Commission, France, Germany, Japan, Korea, Luxembourg, Russia, Saudi Arabia, the United States, and the United Kingdom

What is the National Agriculture Code, currently being formulated by Bureau of Indian Standards

<u>Sub : Schemes</u>

<u>Sec: Agri</u>

National Agriculture Code (NAC):

- The **Bureau of Indian Standards (BIS)** is working on developing a **National Agriculture Code (NAC)**, similar to the existing **National Building Code** and **National Electrical Code**.

Why is the NAC Needed?

- **BIS** already sets standards for **agricultural machinery** (tractors, harvesters) and inputs (fertilizers, pesticides).
- However, **many critical areas in agriculture lack standards**, such as field preparation, micro irrigation, and water use.
- There's a need for a **comprehensive standards framework** that covers all agricultural practices and helps guide policymakers and farmers.

Key Components of the NAC:

- The **NAC** will cover the **entire agriculture cycle** and will serve as a guide for farmers, agricultural universities, and field officials.
- It will include:
  - **General principles for all crops**.
  - **Crop-specific standards** for paddy, wheat, oilseeds, pulses, etc.

What the NAC Will Cover?

The NAC will set standards for:

- **Agricultural machinery** and processes.
- **Post-harvest operations**: crop selection, land preparation, irrigation, soil/plant health, harvesting, primary processing, sustainability, and record maintenance.
- **Input management**: chemical fertilizers, pesticides, weedicides.
- **Crop storage and traceability**.
- **Emerging areas**: natural farming, organic farming, and **IoT-based agriculture**.

Objectives of the NAC:

- Create an **implementable national code** that accounts for **agroclimatic zones, crop types,** and the **socio-economic diversity** of **Indian agriculture.**
- Promote a **quality culture** by providing a reference for **policymakers, agriculture departments,** and **regulators.**
- Offer a **comprehensive guide** for effective decision-making in agricultural practices.
- Integrate **Indian Standards** with recommended agricultural practices.
- Address **SMART farming, sustainability**, and traceability.
- Assist **capacity-building** programs for farmers via extension services and civil society organizations.

Timeline and Development Process:

- **Working panels** involving university professors and R&D organizations have been formed to draft the NAC, focusing on 12-14 key areas.
- The tentative deadline for completing the NAC is **October 2025**.
- After finalization, **training programs** will be organized for farmers, with BIS providing financial support.

Standardized Agriculture Demonstration Farms (SADF)

- **BIS** is also setting up **Standardized Agriculture Demonstration Farms (SADF)** at selected agriculture institutes to test and implement agricultural practices based on Indian Standards.
- These farms will:
  - Serve as **experimental sites**.
  - Be used by farmers, officials, and industry experts to learn about new technologies and practices.

- **10 premier agricultural institutes** have been identified for this project, with **MoUs** being signed for development.
- The **Pantnagar-based Govind Ballabh Pant University of Agriculture and Technology (GBPUAT)** is one of the first institutes involved.

Importance of SADFs

- They will be used for **practical demonstrations** to train farmers and officials.
- The BIS is providing **financial support** for setting up these farms, learning from similar initiatives already implemented in **China**.

Weather forecasts at panchayat level: what will be known, and how it will help

Sub : Schemes

Sec: Agriculture

Context:

- On October 24, a new scheme named the **Gram Panchayat-Level Weat her Forecasting initiative** was launched by the Central Government.
- The Panchayati Raj Ministry is organizing workshops to train over 200 participants, including elected representatives, on utilizing weather forecasting tools at the gram panchayat level. This aims to **empower communities and enhance climate resilience**.

About the initiative:

- This program is a collaborative effort between the **Panchayati Raj Ministry, the India Meteorological Department (IMD), and the Ministry of Earth Sciences**.
- Five-day weather forecasts, updated every hour, are now available at the level of gram panchayats, the first major step towards localised forecasting across the country.
- Forecasts will be accessible via the e-**GramSwaraj and Gram Manchitra portals**, and the **Meri Panchayat app.**

Types of Forecasts:

- Users can see data on the **current** temperature, wind speed, cloud cover (in percentage), rainfall, and relative humidity at the level of gram panchayats.
- It also provides **five-day forecasts** of minimum and maximum temperatures, rainfall, cloud cover, wind direction, and wind speed, and an **overall weather forecast**.

Benefits of the initiative:

- Farmers can utilize localized forecasts to optimize planning for sowing, irrigation, and harvesting.
- The initiative can improve **preparedness against natural disasters**, particularly as weather patterns become increasingly unpredictable due to climate change.

Importance of Localized Weather Forecasting:

- Predicting large weather systems (e.g., monsoons, cyclones) is easier than forecasting sudden localized events (e.g., cloudbursts).
- Localized forecasts empower small communities, particularly farmers, to make informed economic decisions.

Current Capabilities:

- At present, IMD provides weather forecasts at the **district and block levels**, with forecasts for a **12 km x 12 km area**.
- IMD is testing forecasts for 3 km x 3 km grids, with the eventual objective of making **hyper-local forecasts for 1 km x 1 km areas.**

Odisha's Rising Construction Worker Registrations Amid Employment Challenges

Sub : Schemes

Sec: Economy

- **Significant Increase in Registrations with OBCWWB**:
  - **Over 42.66 lakh people** have registered as construction workers with the **Odisha Building and Other Construction Workers' Welfare Board (OBCWWB)**.
  - Almost every daily wage earner in Odisha is now identifying as a construction worker.
  - **Registrations** are driven by workers' need to access **welfare benefits** provided by OBCWWB, which include assistance for **accidents, medical emergencies, education, and housing** under schemes like **Nirmana Shramik Pakka Ghar Yojana**.
- **Mismatch Between Registrations and Sector Capacity**:

- o Experts argue that the **construction sector in Odisha** is not large enough to support such a huge labor force.
- o The number of **registered workers (42 lakh)** significantly exceeds the sector's realistic employment capacity.
- o Many casual laborers identify as construction workers to access **social security** benefits, leading to the issue of **"ghost beneficiaries"**.
- **OBCWWB Welfare Fund and Collection**:
    - o A **1% construction cess** is collected from all construction activities in the state, which is deposited into the **OBCWWB Fund**.
    - o **₹4,571.84 crore** has been collected so far, and **₹3,588 crore** has been spent on welfare measures.
    - o The government now targets to collect **₹1,000 crore annually** for the fund.
- **Economic and Employment Data from Odisha**:
    - o According to the **Odisha Economic Survey 2023-24**, the state has a population of **351 lakh people** in the age group of 15 and above, out of which **214 lakh** are part of the **labour force**.
    - o Of this labor force, **96% (205.3 lakh)** are employed. **64% (131.6 lakh)** are **self-employed**, and the remaining **36%** are either **regular wage workers or casual workers**.
    - o **Odisha's unemployment rate** for the first quarter of this fiscal is **8.2%**, higher than the **all-India average of 5.8%**.
- **Limited Job Creation and Skills Mismatch**:
    - o The construction sector cannot accommodate the vast number of registered workers, highlighting the **employment challenges**.
    - o Between **2020 and 2024**, **9,90,696** people registered at employment exchanges in the state, but only **1,176** obtained jobs.
    - o Odisha faces a **skills gap**, with a large number of technical jobs going to workers from outside the state due to local workers lacking **requisite skills**.
- **Government Initiatives and Promises**:
    - o The BJP, which came to power in Odisha in May 2024, promised to create **1.5 lakh jobs** in the **government sector**.
    - o The government has also committed to creating more than **3.5 lakh jobs** in sectors like **automobiles, semiconductors, and IT/ITES**.
    - o **65,000 vacant government positions** are expected to be filled in the next two years, with recruitment to be fair and transparent.

In conclusion, the surge in registrations with OBCWWB reflects the **desperation of workers** in Odisha to access **social security benefits**, while the state's **employment scenario remains challenging** with a high unemployment rate and a significant skills gap.

Building and Other Construction Workers Act, 1996

This Act was introduced to regulate the **employment conditions** and ensure the **welfare** and **safety** of construction workers. It applies to any establishment employing **10 or more workers** in building or other construction work.

- **Welfare Provisions:**
    - o Establishment of **Welfare Boards** at state levels.
    - o Registration of workers to provide them access to welfare schemes.
    - o Benefits such as **maternity leave**, **accident insurance**, **pension**, and **housing assistance**.
- **Regulation of Employment:**
    - o Regulates working hours, wages, and employment conditions.
    - o Promotes safety measures at construction sites to prevent hazards.
- **Establishment of Cess:**
    - o A **cess (tax)** is levied on employers, which funds welfare measures for workers.
- **Coverage:**
    - o Covers all workers involved in construction, including building roads, bridges, and projects requiring manual labor.
- **Social Security Schemes:**
    - o Includes **health insurance**, **disability compensation**, **scholarship schemes** for children, and other financial support systems.

Nirman Shramik Pakka Ghar Yojana (Odisha)

This is a welfare scheme by the Government of Odisha aimed at providing **permanent houses** to **registered construction workers** in the state.

- **Eligibility:** Registered construction workers under the Odisha Building and Other Construction Workers' Welfare Board.
- **Financial Assistance:** Workers are provided monetary support for building **pucca houses**.
- **Objective:** To improve the living conditions of workers by ensuring they have durable housing.

Govt. opens portal for internships to bridge skill set gap
Sub: Schemes

Sec: Eco

Context:
- The **Prime Minister's Internship scheme** that aims to provide **internship to one crore youth in top 500 companies over five years** opened its portal for companies to register their internship opportunities for the pilot phase.

About the portal:
- It was developed by the Ministry of Corporate Affairs.
- The portal **mca.gov.in** will open for enrollment for youth aged 21 to 24.
- Open from October 12 (Vijaya Dasami) to October 25 for the first batch.
- **Candidates' information will be matched with the needs and locations of companies** using **artificial intelligence** This will generate a shortlist of candidates for companies to review.

About the scheme:
- The scheme was announced in **union budget 2024-25**.
- **Objective:**
  - To provide **internship to one crore youth in top 500 companies over five years**
  - To **bridge the skills gap** between unemployable youth and the skills required by employers.
- **Implemented by:** Ministry of Corporate Affairs (MCA)
- The companies participating in the scheme were selected based on their **average Corporate Social Responsibility (CSR) expenditure** over the last three years.
- The internships, which will last for 12 months, will focus on **real-world job environments**, with **at least half of the internship period dedicated to hands-on work experience**.
- Interns will receive a **monthly stipend of ₹5,000**, with ₹4,500 provided by the government and ₹500 contributed by the company from its CSR funds.
- A one-time grant of ₹6,000 for incidental expenses will also be provided by MCA when interns join their workplace.
- A **grievance redressal mechanism and a multilingual helpline (1800-116-090)** have been established to support applicants and ensure a smooth internship process.

Eligibility:
- Indian nationals **not employed full-time or engaged in full-time education**.
- High school or higher secondary graduates.
- Candidates with ITI certificates, diplomas from polytechnic institutes, or degrees like BA, B.Sc, B.Com, BCA, BBA, or B.Pharma.
- Unemployed youth enrolled in online or distance learning courses.

Scheme is not open to:
- Post-graduates
- Children of permanent employees in Union or State governments.
- Graduates from premier institutions (IITs, IIMs, NIDs).
- Professionals with qualifications like CA, CS, or MBBS.
- Individuals from households that includes a person who earned an income of ₹8 lakh or more in 2023-24.
- Those currently in any government-sponsored skilling, apprenticeship, internship, or training programs.

PM opens 3 airports in Chhattisgarh, Madhya Pradesh, Uttar Pradesh under UDAN scheme
Sub: Schemes

Sec: Eco

Context:
- Prime Minister Narendra Modi virtually inaugurated three airports across the country in **Chhattisgarh's Surguja, Madhya Pradesh's Rewa and Uttar Pradesh's Saharanpur.**

- The Maa Mahamaya Airport at Ambikapur in Surguja district of Chhattisgarh is the first airport in Chhattisgarh's northern tribal belt.
- The airports have been developed under the **Regional Connectivity Scheme (RCS) – UDAN (Ude Desh Ka Aam Nagrik)** of the Central government.

About UDAN Scheme:
- UDAN (Ude Desh Ka Aam Nagrik) is the Government's initiative improve **infrastructure and connectivity** in India, especially in **remote and underserved regions**.
- It aims to make air travel to India's **tier II and tier III** cities affordable to Common man.
- Under the scheme, the Government offers incentives to airlines to flag off new flights to neglected smaller cities and towns by providing **Viability Gap Funding** to make these operations profitable.
- It is a vital component of India's **National Civil Aviation Policy (NCAP) 2016**, launched by the **Ministry of Civil Aviation** (MoCA) on October 21, 2016, with a 10-year vision.
- The first RCS-UDAN flight was inaugurated in 2017, connecting **Shimla to Delhi**.

Various versions of UDAN Scheme:
- **UDAN 1.0:** Awarded 128 flight routes to 70 airports, including 36 new ones.
- **UDAN 2.0:** Announced 73 underserved/unserved airports, incorporating helipads.
- **UDAN 3.0:** Introduced Tourism Routes in partnership with the Ministry of Tourism.
- **UDAN 4.0:** Focused on North-Eastern Regions, hilly states, and islands.

UDAN version 5 series:
- **UDAN 5.0:** Focus on Category-2 (20-80 seats) and Category-3 (>80 seats) aircraft.
- **UDAN 5.1:** Aimed at enhancing helicopter operations.
- **UDAN 5.2:** Aimed at improving connectivity to remote areas and boosting tourism with small aircraft (<20 seats).
- **UDAN 5.3:** Launched in January 2024 to revive previously discontinued routes.
- **UDAN 5.4:** Ongoing bidding for additional connectivity opportunities.

Achievements of the scheme:
- RCS-UDAN has enhanced **last-mile connectivity** and given significant boost to tourism.
- The scheme has catalysed the growth of the civil aviation industry over the past seven years, **enabling new airlines** like Flybig, Star Air, IndiaOne Air, and Fly91 to establish sustainable business models. This has fostered a **supportive ecosystem for regional airline operators.**
- RCS-UDAN has successfully connected 34 states and UTs, operationalizing 86 aerodromes, including ten in the Northeast.

Relaunch of eShram Portal with Enhanced Features for Gig Workers
Sub: Schemes

Sec: Eco

Overview:
- The **eShram portal**, originally launched on **August 26, 2021**, has been **reintroduced** with new features aimed at better serving **unorganised workers** including **gig and platform workers**.
- **Union Labour Minister** announced the relaunch, emphasizing the platform's goal of streamlining access to **social security** and **welfare schemes** via a **one-stop solution**.
- The portal registers workers on a **self-declaration basis**, and approximately **60,000 to 90,000** new users sign up every day.
- The Labour Ministry has allocated **₹300 crore** to enhance the eShram portal, aiming to address existing issues and improve user experience.
- Recent discussions with **platform aggregators** like **Urban Company, Swiggy, Zomato, Ola, Uber**, and industry bodies have emphasized the need to register **gig workers** on the eShram platform, ensuring better social security coverage.

Key Enhancements and Features:
- **Integration with Central Schemes:**
  - The portal has integrated **12 central schemes**, providing users easy access to a variety of government benefits.
- Some of these schemes include:
  - **Ration Card**

- o **PM Street Vendor's AtmaNirbhar Nidhi (PM SVANidhi)**
- o **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)**
- o **Pradhan Mantri Awas Yojana Gramin (PMAY-G)**
- o **Pradhan Mantri Shram Yogi Maandhan**
- o **National Disability Pension**
- o **National Widow Pension**
- o **PM Matisya Sampada Yojana (PMMSY)**
- o **Skill India Digital Hub (SIDH)**
- **eShram Card 2.0:**
  - o The **enhanced version**, known as **eShram Card 2.0**, focuses on **gig and platform workers** who do not have a conventional employer-employee relationship.
  - o A special committee has been set up to develop a framework that ensures these workers receive **social security benefits**.
  - o **Unique IDs** will be issued to gig workers, offering them access to a comprehensive set of benefits.
- **Nationalized Database Linked with Aadhaar:**
  - o The platform is integrated with **Aadhaar**, ensuring that the data of unorganised workers is consolidated in a **nationalized database**.
  - o The Finance Minister had earlier stated that **full integration** of eShram with other portals will enhance access to services like **employment** and **skill development**.
- **Social Security Benefits:**
- eShram cardholders are entitled to:
  - o **₹2 lakh life insurance**
  - o **₹3,000 pension per individual** or **₹6,000 per couple** after retirement.
  - o **₹1 lakh financial aid** for partially handicapped workers.

Govt. doubles loan limit under Mudra Yojana to ₹20 lakh
Sub : Schemes

Sec: Eco

Context:
- The government has doubled the **loan limit** under the **Pradhan Mantri Mudra Yojana (PMMY)** from **₹10 lakh to ₹20 lakh.**
- This initiative is part of the government's broader strategy to foster a robust entrepreneurial ecosystem, facilitating growth and expansion for emerging entrepreneurs.

New Tarun Plus Category:
- A new category called **Tarun Plus** has been introduced for loans **above ₹10 lakh and up to ₹20 lakhs**.
- The enhanced loan limit is specifically available to entrepreneurs who have successfully availed **and repaid loans under the Tarun category,** which allows loans up to ₹10 lakh.

Pradhan Mantri Mudra Yojana (PMMY):
- The Pradhan Mantri MUDRA Yojana (PMMY) was launched in 2015, with the aim to facilitate **easy collateral-free micro credit of up to ₹10 lakh** to non-corporate, non-farm small and micro entrepreneurs for income generating activities.
- It aims to promote entrepreneurship by funding the unfunded.

Key Features:
- **Loan Categories**:
  - o **Shishu**: Loans up to ₹50,000
  - o **Kishore**: Loans above ₹50,000 and up to ₹5 lakh
  - o **Tarun**: Loans above ₹5 lakh and up to ₹10 lakh
- **Loan Limit Enhancement**: As of the 2024-25 budget, the loan limit for the Tarun category has been increased to ₹20 lakh for entrepreneurs who have successfully repaid previous loans.
- **Eligibility**: Micro and small enterprises, individuals, and self-help groups (SHGs) engaged in non-farm activities.

Implementation:

- The loans under PMMY are provided by **Member Lending Institutions (MLIs),**e., Banks, Non-Banking Financial Companies (NBFCs), Micro Finance Institutions (MFIs) and other financial intermediaries.

Credit Guarantee Coverage

- Loans granted under the PMMY for amounts up to ₹20 lakh will have guarantee coverage provided under the **Credit Guarantee Fund for Micro Units (CGFMU).**
- This coverage aims to **reduce the risk for lenders** and encourage them to support aspiring entrepreneurs.

Modi says toilet coverage reached 100% after launch of Swachh Bharat Mission

Sub : Schemes

Sec: Health

Context:

- 2024 marks the **10th anniversary** of the Swachh Bharat Mission.

Swachh Bharat Mission (SBM)

- The SBM or Clean India Mission was launched on October 2, 2014, to **eliminate open defecation and improve solid waste management**.
- **Target population:** Particularly aimed at improving sanitation for marginalized communities (Dalits, tribals, women).
- The **urban component** of the mission is implemented by the **Ministry of Housing and Urban Affairs**, and the **rural component by the Ministry of Jal Shakti**.
- **Community Participation:** Engaged NGOs, celebrities, and local communities to promote cleanliness and sanitation as a public movement.

Key Achievements:

- Over **12 crore** toilets constructed since the launch.
- Toilet coverage increased from less than **40% to 100%.**
- Increased awareness and participation in sanitation initiatives.

Swachh Bharat Mission (Gramin)

- The SBM(G) was launched on 2nd October 2014. It aimed to ensure cleanliness in rural areas through Solid and Liquid Waste Management activities and make India **Open Defecation Free (ODF) in Five Years (2014-2019)**.
- Having achieved the milestone of an ODF India, the aim now is **overall cleanliness (Sampoorn Swachhata)** in villages. e., **sustaining the ODF status and managing solid and liquid waste by 2024-25** and transforming all the villages from **ODF to ODF Plus Model.**

Swachh Bharat Mission Urban (SBM - U)

- Launched on October 2, 2014, as part of the broader Swachh Bharat Mission, SBM-U focuses on enhancing **sanitation and hygiene in urban areas** across India.
- **Objectives:**
  - o elimination of open defecation
  - o conversion of unsanitary toilets to pour flush toilets
  - o eradication of manual scavenging
  - o municipal solid waste management and
  - o bringing about a behavioural change in people regarding healthy sanitation practices.

SBM-U 2.0:

- The Swachh Bharat Mission-Urban (SBM-U) 2.0 was launched in 2021 along with Atal Mission for Rejuvenation and Urban Transformation 2.0.
- It aims to make all cities **'Garbage Free'**.
- SBM-U 2.0 will ensure **grey and black water management** in all cities, other than those covered under AMRUT.
- The mission focusses on **source segregation** of solid waste.

Swachh Bharat Kosh:

- The government in 2014 formally launched the Swachh Bharat Kosh (fund) to facilitate channelisation of **philanthropic contributions and Corporate Social Responsibility (CSR)** funds towards this cause.
- The fund is aimed at finance activities such as **construction of new toilets as well as repair and renovation of dysfunctional toilets** in rural areas, urban areas, elementary, secondary and senior secondary government schools, anganwaadis.

Significance of the mission:
- The initiative is critical for improving **public health and hygiene** standards in India.
- Aligns with global goals for sustainable development, particularly in sanitation (SDG 6).

Impact on Society:
- Addressed issues of **dignity and health**, especially for women and marginalized groups.
- **Changed public perception of sanitation workers** (safaimitras), leading to increased respect and pride in their work.
- Increased awareness and participation in sanitation initiatives.

Key Terminology:
- **Safaimitras:** Sanitation workers involved in cleaning and maintaining hygiene.
- **Open Defecation Free (ODF):** A status indicating that a community has eliminated open defecation.
- **ODF Plus:** ODF Plus refers to a village that has maintained its Open Defecation Free (ODF) status and has solid and liquid waste management systems in place.

Three stages of ODF Plus villages:
- **ODF Plus Aspiring:** A village that has ODF status and either solid or liquid waste management
- **ODF Plus Rising:** A village that has ODF status and both solid and liquid waste management
- **ODF Plus Model:** A village that has ODF status, both solid and liquid waste management, and is **visually clean**.

What is the status of the Swachh Bharat Mission 2.0?
Sub: Schemes

Sec: Health

Legacy Waste Dumpsites in India
- The Central Government launched the ***Legacy Waste Management Project*** under the ***Swachh Bharat Mission (SBM) 2.0*** in **October 2021,** aiming to remediate these dumpsites by **2026**.
- **Current Status**:
  - **India** has over **3,000 legacy waste dumpsites**.
  - **2,424 dumpsites** have waste loads exceeding **1,000 tonnes**.
  - Only **471 (19.43%)** of the **2,424 dumpsites** have been fully remediated halfway through the project period.

What are Legacy Waste Dumpsites?
- These dumpsites contain ***unmanaged solid waste*** accumulated over many years in an unscientific manner.
- **India** generates approximately **1,50,000 tonnes** of municipal solid waste daily (as per the ***State of India's Environment 2023*** report).
- Due to a lack of solid waste management infrastructure, ***municipal corporations*** often create ***garbage hills*** in city outskirts, which are now part of urban areas due to city expansion.
- Around **16 crore tonnes** of **legacy waste** is spread across *15,000 acres* of prime land in India.

Health Hazards of Legacy Waste
- Exposure to emissions from legacy dumpsites can cause:
  - Irritation of the mouth and throat.
  - **Methane exposure** leading to nausea, vomiting, and coordination loss.
  - Ragpickers often suffer from **skin allergies** due to prolonged waste exposure.
  - Residents near landfills may develop **tuberculosis, asthma, diabetes, depression, cholera, malaria,** and other diseases.
- These dumpsites also emit significant amounts of ***greenhouse gases*** like **methane** and **carbon dioxide.**

Swachh Bharat Mission (SBM):
- Launched on **October 2, 2014**, the *Swachh Bharat Mission* aimed to **eliminate open defecation** and create **Open Defecation Free (ODF) villages.**
- **SBM-Urban 2.0 (2021-2026)**:
  - Focus on making all cities **"garbage-free"** and maintaining **ODF status**.
  - Includes goals like **100% source segregation, door-to-door waste collection**, and **scientific waste management**.
  - **Aims** to remediate all legacy dumpsites and convert them into **green zones.**
  - Provisions for *scientific landfills* to prevent the creation of new dumpsites.

Progress on Dumpsite Remediation

- As of September 2024, out of **2,424 dumpsites:**
    - **471** have been fully remediated.
    - **1,226** are under remediation.
    - **727** sites remain untouched.
- **Land Reclamation**:
    - **27%** of the total **17,039 acres** of dumpsite land has been reclaimed.
    - **Tamil Nadu** leads with **837 acres (42%)** reclaimed.
    - **Gujarat** has reclaimed **75% of its landfill area** (698 out of 938 acres).

Financial Aspects

- Central Share assistance of **₹3,226 crore** has been approved for remediation projects.
- State and Union Territory governments are required to provide matching funds.

Revamping Tuberculosis Treatment Through Improved Nutrition and Support Systems

Sub :Schemes

SEC: Health

Why in News

The **Ministry of Health and Family Welfare** has recently announced a significant increase in financial and nutritional support for **tuberculosis (TB) patients.** The doubling of the **Direct Benefit Transfer (DBT)** under the **Nikshay Poshan Yojana (NPY)** from ₹500 to ₹1,000 per month, alongside a one-time ₹3,000 transfer at diagnosis and energy-dense nutritional supplements, aims to enhance treatment outcomes and alleviate the socio-economic burden on TB patients.

What is Tuberculosis?

Tuberculosis (TB) is an infectious **airborne bacterial disease** caused by **Mycobacterium tuberculosis.**

TB commonly affects the **lungs (pulmonary TB)** but can also affect **other parts (extrapulmonary TB)**

Tuberculosis **spreads** from person to person **through the air**, when people who are infected with TB infection cough, sneeze or otherwise transmit respiratory fluids through the air.

Genome Size: Mtb's genome consists of **4.4 million base pairs**, far larger than other respiratory bacteria like **Staphylococcus aureus (2.8 million)** and **Streptococcus pneumoniae (1.9-2.7 million)**. This extensive genome enables Mtb to produce a wide variety of proteins to evade immune defenses.

India faces a severe TB burden, with 3 million new cases annually and 3,00,000 TB-related deaths.

About Nikshay Poshan Yojana (NPY):

Nikshay Poshan Yojana provides **nutritional support to TB patients** in India to enhance treatment outcomes, initiated under the **National TB Elimination Program (NTEP) by the Ministry of Health and Family Welfare.**

TB patients receive a direct benefit transfer (DBT) of ₹500 per month for the duration of their treatment to cover nutritional needs. The **DBT has been increased from ₹500 to ₹1,000 per month, covering the entire treatment period.** Additionally, a one-time payment of ₹3,000 is provided at the time of diagnosis.

All TB patients notified on the NIKSHAY portal after April 1, 2018, are eligible for the scheme, including those already under treatment.

The scheme plays a key role in improving TB notification rates, ensuring early diagnosis and treatment while addressing undernutrition, a major contributor to TB in India.

By providing nutritional and financial support, Nikshay Poshan Yojana aims to reduce mortality and improve treatment adherence, particularly for vulnerable and undernourished populations.

The **NIKSHAY-TB Notification incentive also encourages private healthcare providers to report TB cases,** aiding government efforts in TB control and patient tracking.

Nikshay Mitra Reforms: The program's **coverage of vulnerable communities should be enhanced,** and measures should be taken to eliminate stigmatizing practices, such as publicizing patients receiving food baskets.

Shah unveils mobile app for birth and death registration

Sub: Schemes

Sec: Health

Context:

- Union Home Minister Amit Shah introduced the **Civil Registration System (CRS) mobile application** aimed at enhancing governance through technology. This initiative is expected to streamline the registration of births and deaths across the country.
- The app was developed by the **Registrar General and Census Commissioner of India**.

Features of the CRS mobile app:
- The application allows citizens to register births and deaths at **any time and from any location**, using their **state's official language**.
- The app will significantly reduce the time required for registration, making the process more hassle-free for users.

Digital Registration Mandate:
- According to the **Registration of Births and Deaths (Amendment) Act, 2023**, all births and deaths reported in the country from **October 1, 2023,** will need to be digitally registered through the official portal, **crsorgi.gov.in**.
- The digital birth certificates generated will serve as a **single document** to validate the date of birth for various essential services, including educational admissions, government job applications, and marriage registrations.

Other purposes:
- The centralised database of CSR will help update the **National Population Register (NPR), ration cards, property registration and electoral rolls**.

PM to launch National Learning Week today
Sub :Schemes

Sec: Msc

Context:
- Prime Minister Narendra Modi is set to launch the **Karmayogi Saptah or National Learning Week** on Saturday.
- The initiative aims to give fresh momentum to the capacity development of civil servants, focusing on both individual and organizational growth.
- The program is **part of the broader Mission Karmayogi framework**, which was launched in September 2020.

Mission Karmayogi:
- Mission Karmayogi focuses on the holistic development of civil servants, ensuring they **acquire the right skills, attitudes, and competencies to meet the challenges of governance in the 21st century.**
- The program focuses on both individual skill enhancement and organizational capacity building.
- It seeks to foster a civil service that is capable of handling complex governance challenges through **lifelong learning**.

iGOT Karmayogi:
- A digital learning platform named iGOT Karmayogi has been launched under the scheme to provide a centralized and integrated platform for learning and development.
- The **platform offers online courses, training programs, and resources for civil servants.**

National Learning Week (NLW):
- Karmayogi Saptah - National Learning Week (NLW) is an initiative to inspire and energize civil servants towards achieving a culture of continuous learning and capacity building.
- The week-long program aims to foster a **One Government** vision by instilling a commitment to lifelong learning and self-improvement for over 3 million central civil servants, ensuring they remain up-to-date with evolving administrative requirements.

Learning Target:
- During National Learning Week, each participant (referred to as karmayogi) will be required to complete at least four hours of competency-linked learning.
- The learning modules will be accessible through **iGOT (Integrated Government Online Training)** and will include role-based modules tailored to individual roles.

Rules to get disability certificates tweaked: the changes, why they are being opposed
Sub : Schemes

Sec :Vulnerable population

Context:
- The government has introduced the **Rights of Persons with Disabilities (Amendment) Rules, 2024 (RPwD Rules)**, aiming to enhance the processes for applying for disability certificates and Unique Disability Identity (UDID) cards.

- These amendments come in light of recent controversies, including the dismissal of IAS probationer Puja Khedkar for alleged forgery of disability and caste certificates.

Key changes in the RPwD rules:
- The RPwD Amendment Rules have made changes in **Rule 17 and Rule 18**.
- **Rule 17** relates to the mode of application, the authority to apply to, and the documents to be submitted.
- **Rule 18** relates to the issuance of disability certificates and UDID cards once the applications are received, and the timeframe to issue them.

Colour-coded cards:
- The amended rules specify the issuance of color-coded UDID cards based on the severity of disability:
  - White Card: For disabilities below 40%.
  - Yellow Card: For disabilities between 40% and 80%.
  - Blue Card: For disabilities of 80% and above.
- The severity of disability is examined using the government's **assessment guidelines**, which assess twenty-one different kinds of disabilities and their extent or severity.

Changes in submission of application:
- Applications must be submitted **exclusively through the UDID portal** and statutory backing has been given to UDID cards.
- Applications can only be made to a **notified competent medical authority in the applicant's district**. This clarifies the previous ambiguity about the competent authority.
- Additional documents required: Proof of identity, a recent photograph (not older than six months) and Aadhaar number.
- UDID card can now be issued **within three months** as opposed to a month previously.
- An application can be considered **void if no decision is taken** by the relevant medical authority **for two years**.

Criticism of the amendment:
- The requirement to submit applications solely through the UDID portal assumes that all applicants are comfortable with **digital technology,** which may not be the case for many individuals in the disability community.
- The emphasis on submitting applications to a notified competent medical authority limits access to **independent medical experts from trusts and non-profits**, who often assist in the certification process
- Activists also argue that extending the issuance period to three months **could delay urgent certifications needed** for educational purposes or reservation benefits.

Health Ministry asks States to ensure permanent organ transplant coordinators
Sub : Schemes

Sec : Sci

Context:
- The Union Health Ministry has issued a warning to states and institutions operating without regular transplant coordinators.
- It has stated that requests for support in this area will not be entertained beyond the **financial year 2024-25** from States and institutions that have exceeded the **five-year support period**.

National Organ Transplant Programme:
- Under the current National Organ Transplant Programme, which runs from **2020-21 to 2025-26**, there are provisions to **support government medical colleges with two transplant coordinators** and a trauma centre, while private medical colleges performing well can receive support for one transplant coordinator.
- The commitment for transplant coordinator positions is set for five years. During this time, state governments and medical colleges are expected to establish permanent positions.
- However, the Health Ministry noted a lack of significant progress in creating these roles.

Role of Transplant Coordinators:
- The transplant coordinator plays a critical role in coordinating the entire process of deceased organ donation and transplantation. Their responsibilities include:
  - Coordinating brain stem death identification and certification.
  - Providing grief counselling to families.
  - Encouraging family members to consider organ donation.
  - Obtaining consent for donation.

o   Managing logistics related to organ retrieval and transplantation.

Legal Framework:

- Organ donation in India is regulated by the **Transplantation of Human Organs and Tissues Act** (THOTA).
- According to this act, hospitals must appoint a transplant coordinator with the required qualifications and experience to be registered for transplantation procedures.
- The Ministry has reiterated that having a transplant coordinator is a **legal requirement** for hospitals involved in transplantation or organ retrieval.
- States and institutions are now instructed to take necessary steps to create permanent posts for transplant coordinators by the next financial year.

Organ transplant in India:

- India faces an acute shortage of organs for transplants.
- India currently has about 750 institutions providing organ transplant services.

Science and tech

The Discovery of microRNAs: A Landmark in Gene Regulation and its Implications for Medicine

Sub: Sci

Sec: Biotech

Why in News

The **2024 Nobel Prize in Physiology or Medicine** has been awarded to **Victor Ambros** and **Gary Ruvkun** for their groundbreaking discovery of **microRNAs**—small RNA molecules that play a critical role in gene regulation. This discovery has transformed our understanding of how genes are expressed in cells and opened new pathways for medical research, particularly in cancer, diabetes, and autoimmune diseases.

Revolutionizing Gene Regulation Understanding

Prior to the discovery of microRNAs, it was believed that **gene regulation** mainly involved **transcription factors**—**specialized proteins that bind to DNA** and determine which genes produce **messenger RNA (mRNA)**.

Ambros and Ruvkun's research demonstrated that **gene regulation** extends beyond transcription factors. MicroRNAs regulate gene expression at a later stage, **post-transcription**, after mRNA is produced but before proteins are synthesized.

About MicroRNAs (miRNAs):

They are small RNA molecules that regulate gene expression in **eukaryotes** by interfering with the translation of mRNA into proteins.

The discovery began with experiments on **C. elegans**, a tiny roundworm, where researchers showed that gene regulation can happen **post-transcription**, challenging the previous understanding that it was solely the domain of transcription factors.

By **2001**, microRNAs were found to be present in **invertebrates and vertebrates**, and many of them were **highly conserved across species**, indicating that microRNA-mediated regulation is a **universal mechanism**.

MicroRNAs (miRNAs) are **small, non-coding RNA molecules,** approximately **21-24 nucleotides** in length, involved in regulating gene expression.

miRNAs bind to **messenger RNA (mRNA)** in the cell cytoplasm to control gene expression.

They either trigger the **degradation** of mRNA or prevent it from being translated into proteins, thereby regulating protein production.

Under expression of miRNA can lead to overexpression of the protein it controls, while **overexpression** of miRNA results in underproduction of the associated protein.

miRNAs are involved in key biological processes such as **development, cell differentiation, proliferation**, and **apoptosis** (programmed cell death).

They help maintain **cellular homeostasis** and respond to environmental stimuli.

Alterations in miRNA expression contribute to diseases like **cancer, autoimmune disorders**, and other human conditions.

Circulating miRNAs are considered potential **biomarkers** for **diagnosis and prognosis** of various diseases due to their stability in human fluids.

What is RNA?

RNA (Ribonucleic Acid) is a single-stranded molecule composed of **ribose sugar, phosphate groups**, and **nucleotide bases** (adenine, guanine, cytosine, uracil).

It plays a crucial role in various biological processes, mainly in **coding, decoding, regulation, and expression** of genes.

Types of RNA:

Messenger RNA (mRNA): Carries genetic information from **DNA to the ribosome,** where proteins are synthesized.

Transfer RNA (tRNA): Helps in **translating mRNA into proteins** by bringing amino acids to the ribosome during protein synthesis.

Ribosomal RNA (rRNA): A structural **component of ribosomes,** essential for **protein synthesis.**

MicroRNA (miRNA): Regulates **gene expression by binding to mRNA,** either degrading it or inhibiting its translation into protein.

RNA plays a central role in the process of **transcription** (copying genetic code from DNA to RNA) and **translation** (using mRNA to build proteins).

RNA is **single-stranded** (unlike double-stranded DNA).

RNA contains **uracil** instead of thymine, which is found in DNA.

RNA has a **ribose sugar** instead of deoxyribose found in DNA.

Gene regulation: miRNA and other small RNAs control gene expression.

Catalytic activity: Certain RNAs like ribozymes act as enzymes.

Messenger function: mRNA acts as a template for protein synthesis.

RNA-based technologies, such as **mRNA vaccines**, have become critical tools in developing treatments for diseases, including **COVID-19**.

Genome-Editing Advancements in Understanding and Treating Hereditary Cancers

Sub :Sci

Sec: Biotech

Why in News

Advances in **CRISPR-based genome-editing** techniques are improving the understanding of hereditary cancers, including how certain genetic mutations affect cancer development and resistance to targeted therapies. These breakthroughs offer promising new avenues for cancer treatment and personalized medicine.

Global Cancer Statistics:

According to the **International Agency for Research on Cancer**, an estimated 20 million new cancer cases and 9.74 million cancer-related deaths occurred in 2022, projected to rise to **32 million new cases and 16 million deaths by 2045**. Asia may account for almost half of the global cancer burden by 2045.

Around **10% of cancer cases** are caused by **inherited genetic mutations**. The prevalence is notably high in certain cancers, such as ovarian cancer (**20%** of cases), and lower in cervical cancer (**6%**).

Hereditary Cancer: Occurs when an individual inherits mutations in cancer-causing genes. **BRCA1 and BRCA2 mutations** are the most well-studied, causing **Hereditary Breast and Ovarian Cancer (HBOC)**.

The **BRCA gene** *(BRCA stands for BReast CAncer gene)* refers to two genes, **BRCA1** and **BRCA2**, which play a **crucial role in suppressing tumors by repairing DNA damage.** Mutations in these genes can impair their ability to repair DNA, leading to an increased risk of several cancers, particularly **breast and ovarian cancers**.

Germline Mutations: These mutations **predispose individuals to multiple cancers**, including breast, ovarian, prostate, pancreatic, and gastric cancers.

Women with **BRCA mutations** face a **69-72% risk of breast cancer** and a **17-44% risk of ovarian cancer** by age 80. This is significantly higher compared to the general population's lifetime risks of **12% for breast cancer** and **1% for ovarian cancer**.

Preventive Measures: Options like **prophylactic mastectomy and oophorectomy** can reduce the risk of developing cancer by **90-100%** and significantly lower cancer-related deaths.

Genetic bottlenecks and **founder effects** contribute to the higher prevalence of BRCA mutations in certain populations.

The **founder effect** occurs when a small group of individuals becomes isolated from a larger population, leading to reduced genetic diversity. This small group's limited gene pool can result in a higher prevalence of certain genetic traits or mutations, some of which may be harmful. The founder effect is a type of **genetic drift** and can significantly impact the genetic makeup of small, isolated populations.

Genome Editing and Personalized Cancer Therapy:

Testing for BRCA mutations helps in early identification of cancer risk, leading to **personalized prevention strategies**, such as increased surveillance and **targeted therapies**.

CRISPR in Cancer Research: It has revolutionized cancer research by allowing scientists to create specific mutations in BRCA genes, helping to better understand their role in **DNA repair** and **cancer development**.

What is CRISPR-Cas9?

CRISPR is a dynamic, versatile tool that allows us to **target nearly any genomic location** and potentially repair broken genes.

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) are sections of DNA and are sections of genetic code containing **short repetitions of base sequences followed by spacer DNA segments.**

CAS-9 (CRISPR-associated protein 9) is an enzyme. It uses a **synthetic guide RNA** to introduce a double strand break at a specific location within a strand of DNA. It is a system used by bacterial cells to recognize and destroy viral DNA as a form of adaptive immunity.

Targeted Therapies: **PARP inhibitors**, a new class of chemotherapy drugs, show promise in treating cancers caused by BRCA mutations. Clinical trials reveal their effectiveness, especially when combined with **platinum-based chemotherapy**.

Genome-wide CRISPR screens have identified mutations in other **DNA repair genes** that may affect the response to PARP inhibitors, providing insights into why some patients resist these treatments.

About Cancer:

Cancer is a disease characterized by the **uncontrolled growth and spread of abnormal cells within the body.** It can arise in various tissues and organs, leading to the formation of tumours.

Cancer begins with **genetic mutations** that alter the normal behaviour of cells. These mutations can result in the **proliferation of cancerous cells, forming clusters known as tumours.**

The **cancerous cells may detach from these tumours and spread through the lymphatic system or bloodstream,** leading to **metastasis** in other body regions.

Approximately **63% of all deaths in India** are attributed to NCDs, with cancer being a significant contributor.

By **2030**, the economic burden of cancer-related illnesses is projected to reach approximately **$3.55 trillion** in lost output.

Discovery of 'Spatial Grammar' in Gene Expression: Insights for Diagnostic and Therapeutic Advances

Sub :Sci

Sec: Biotech

Why in News

- A groundbreaking study has uncovered a surprising **new 'spatial grammar' of gene expression.** The findings, published in the **journal *Nature*,** offer fresh insights into how the spatial arrangement of **transcription factor binding sites** can influence gene expression, which can potentially inform new diagnostic and therapeutic strategies for diseases like cancer caused by mutations in regulatory elements.

Spatial Influence on Gene Expression

- Research explored how **cells interpret the same genome differently by examining the spatial arrangement of transcription factors** relative to transcription start sites.
- **Transcription Factors**: These proteins **bind to specific DNA sequences** to control the rate at which genetic information is transcribed from DNA to RNA.
- **New Discovery**: The positioning of these transcription factor binding sites—before or after the transcription start site—significantly influences gene expression.
- The team developed tools to **analyse patterns in DNA sequences and performed RNA sequencing on cultured cells** to detect transcription start sites.
- **Activator Transcription Factor**: NRF1 was found to bind before the start site, increasing transcription, while YY1, **a dual-function factor, bound after the start site, sometimes repressing transcription.**
- **Position-Dependent Outcomes**: The binding site's location—either before or after the transcription start site—had different effects on transcription rates. This revealed that the same transcription factor could act as an activator or repressor depending on its spatial positioning.
- **Result**: Contrary to traditional biology, **transcription factors do not always act solely as activators or repressors;** their role can shift depending on spatial factors.

About Transcription Factor:

- Transcription factors are **proteins that bind to specific DNA sequences** to control the transcription of genetic information **from DNA to messenger RNA (mRNA).** They play a critical role in regulating gene expression.
- Transcription factors **either promote (activators) or inhibit (repressors) the process of transcription.**
- **Activators bind to enhancers, promoting the assembly of the transcription initiation complex,** which includes **RNA polymerase.**
- **Repressors, on the other hand, prevent this process by binding to DNA sequences** that block the initiation complex.

Types of Transcription Factors:

- **General Transcription Factors**: Essential for the **transcription of all class II genes that encode proteins.** They help **RNA polymerase** bind to the promoter regions of DNA.
- **Specific Transcription Factors**: **Regulate transcription in a cell type or tissue-specific manner** by binding to enhancer or promoter regions of particular genes.
- Transcription factors are **vital for cell differentiation and development.**

- **By controlling which genes are turned on or off, they allow cells to develop into different types, despite having the same genetic code.** This is crucial in processes like embryonic development and the immune response.
- **Mutations in transcription factors** can lead to **diseases such as cancer, diabetes, and autoimmune disorders.** Hence, understanding their function is vital for fields like biotechnology and medicine.

About NRF1 (Nuclear Respiratory Factor 1)
- NRF1 is a **transcription factor** that **regulates genes involved in mitochondrial function, oxidative phosphorylation, and cellular respiration.** It is essential for mitochondrial DNA transcription, replication, and biogenesis, making it **crucial for energy metabolism in cells.**
- NRF1 plays a role in **neurodegenerative diseases, muscle function, and cancer,** due to its involvement in maintaining mitochondrial health.

About YY1 (Yin Yang 1)
- YY1 is a **multifunctional transcription** factor that **can act as both an activator and repressor of gene transcription.** It binds to specific DNA sequences to regulate genes involved in various cellular processes, including cell growth, differentiation, and apoptosis.
- YY1 is implicated in **numerous diseases, including cancers and developmental disorders,** due to its versatile role in controlling gene expression.

A Nobel Prize and the hunt for patents
Sub: Sci

Sec: Biotech

Context:
- The decision by **Emmanuelle Charpentier** and **Jennifer Doudna** to withdraw their **CRISPR patents** stems from a technical review by the **European Patent Office (EPO)**. This withdrawal marks a surprising turn in the contentious battle over the **intellectual property rights** of the revolutionary **genome-editing technology.**

Key Reasons for Patent Withdrawal:
- **EPO Decision**: The technical appeals board of the EPO found that the duo's **2017 patent** filings **lacked sufficient detail** for others to replicate the **CRISPR method.** As a result, the **patents did not meet the necessary criteria for an invention,** specifically the requirement for a clear and comprehensive description.
- **Patent Criteria**: For a patent to be valid, it must be **novel, non-obvious, usable, and provide clear instructions for replication.** The board concluded that the initial patent application by Charpentier and Doudna failed to fulfill this last requirement.

Broader Issues in Scientific Patenting:
1. **Collaboration and Recognition**: Modern scientific breakthroughs rely on extensive collaboration. The **CRISPR** discovery is a prime example, with numerous co-inventors, such as Martin Jinek and Krzysztof Chylinski, contributing crucial research but receiving less recognition than Charpentier and Doudna.
2. **Unfair Recognition**: Other scientists, like **Virginijus Šikšnys** from **Lithuania**, made significant contributions to **CRISPR** research around the same time as the **Nobel-winning duo** but were largely overlooked due to biases in the global scientific community.
3. **The Role of Institutions**: Major research hubs, like **MIT** and **Harvard**, dominate the recognition and commercialization of discoveries, sidelining researchers from lesser-known institutions. Šikšnys, for example, was one of the first to demonstrate the **programmable DNA cleavage ability of CRISPR-Cas9** but was ignored by journals and awards committees.

About CRISPER Ca9: Gene editing tool:
- **CRISPR-Cas9** (Clustered Regularly Interspaced Short Palindromic Repeats and CRISPR-associated protein 9) is a precision **gene-editing tool** that works like **molecular scissors.**
- **Basic Components:**
1. Guide RNA (gRNA): Targets specific DNA sequences
2. Cas9 enzyme: Cuts DNA at targeted location

Working Mechanism:
- Guide RNA locates target DNA sequence
- Cas9 makes precise cuts in DNA double strand
- Cell's natural repair mechanisms then either:
    - Disable gene through errors in repair
    - Insert new genetic material at cut site

Key Applications:
1. **Medical Research & Treatment:** Gene therapy for genetic disorders, Cancer research and treatment, Drug development, Disease modeling
2. **Agriculture:** Crop improvement, Disease resistance, Yield enhancement, Nutritional value modification
3. **Biotechnology:** Biofuel production, Industrial enzyme development, Material science

Advantages:
- Precise and efficient, Relatively cost-effective, Versatile applications, Easier to use than previous methods

Limitations & Concerns:
1. **Technical:** Off-target effects, Delivery challenges, Efficiency varies by cell type
2. **Ethical:** Human germline editing concerns, Genetic enhancement debates, Biosafety considerations

Recent Developments:
- Base editing refinements
- Prime editing technology
- Improved delivery methods
- Enhanced specificity variants

Impact:
- **2020 Nobel Prize in Chemistry**, Revolutionized genetic research, Growing commercial applications

Why Delhi HC allowed a 60-year-old couple to access dead son's sperm

Sub: Sci

Sec: Biotech

Context:
- The Delhi High Court recently granted a couple in their sixties access to their deceased son's sperm sample, enabling the possibility of **posthumous assisted reproduction**.

About the case:
- A couple in their sixties sought access to their deceased son's sperm sample, **cryopreserved** by a hospital after his death from cancer in 2020.
- The petitioners wish to carry on the legacy of their deceased son and raise a grandchild.
- The hospital refused to release the sperm, citing a **lack of guidelines** for gamete release when there is no spouse.

Sperm banking:
- Sperm banking is the process of collecting and freezing sperm for future use. This can help individuals or couples preserve sperm before medical treatments that might affect fertility or for use in assisted reproductive methods like IVF.
- The stored sperm can be used later to help conceive a child.
- Common among cancer patients as treatments like chemotherapy and radiation can impact sperm count and quality.

Legal Context:
- **Assisted Reproductive Technology Act, 2021:** The Act regulates and supervises all fertility and artificial insemination procedures in India, but primarily considers cases involving married couples.
- **Assisted Reproductive Technology Rules, 2022:** These rules outline the procedure for posthumous retrieval of sperm. Current provisions **only apply when the deceased is married,** and the retrieval request comes from the surviving partner.
- **Surrogacy Regulation Act, 2021:** Only applies to intending couples or women needing surrogacy; does not cover grandparents.

International Practices:

Various countries permit posthumous reproduction with explicit consent:
- **Uruguay:** Requires written consent valid for one-year post-death.
- **Belgium:** Allows it after a six-month waiting period, request should be made within two years.
- **Victoria state (Australia):** Permits reproduction with written/oral consent in the presence of witnesses and a patient review panel's approval.
- **Canada and UK:** Require written consent.
- **Israel:** Excludes the parents and only allows the deceased's female partner to use the sperm sample. However, some exceptions have been made.

Court's Ruling:

- The court ruled that the ART Act did not apply to the case since it was not in force at the time of the son's death.
- It determined there was **no prohibition on posthumous reproduction without a spouse**, allowing for the retrieval of the sperm.
- The court treated sperm samples **as property**, referencing the **Hindu Succession Act**, which designates parents as legal heirs in the absence of a spouse or children.

Ethical Considerations:

- The ruling sets a precedent allowing non-spousal parties to claim rights to retrieve gametes.
- Ethical concerns include the assumption of consent by the deceased and implications for the child, who would grow up without one genetic parent.
- The court emphasized that consent and the welfare of any future child must be considered in such cases.

Revolutionary Discovery of MicroRNA: Unlocking the Secrets of Gene Regulation

Sub : Sci

Sec: Biotech

Why in News

The **Nobel Prize in Medicine for 2024** was awarded to **Victor Ambros and Gary Ruvkun** for their ground breaking **discovery of microRNA** and its role in **post-transcriptional gene regulation.** This discovery has opened new doors in understanding how different types of cells develop, leading to significant advancements in molecular biology and gene regulation.

About MicroRNAs (miRNAs):

They are small RNA molecules that regulate gene expression in **eukaryotes** by interfering with the **translation of mRNA into proteins.**

The discovery began with experiments on **C. elegans**, a tiny roundworm, where researchers showed that gene regulation can happen **post-transcription**, challenging the previous understanding that it was solely the domain of transcription factors.

By **2001**, microRNAs were found to be present in **invertebrates and vertebrates**, and many of them were **highly conserved across species**, indicating that microRNA-mediated regulation is a **universal mechanism**.

MicroRNAs (miRNAs) are **small, non-coding RNA molecules,** approximately **21-24 nucleotides** in length, involved in regulating gene expression.

miRNAs bind to **messenger RNA (mRNA)** in the cell cytoplasm to control gene expression.

They either trigger the **degradation** of mRNA or prevent it from being translated into proteins, thereby regulating protein production.

Under expression of miRNA can lead to overexpression of the protein it controls, while **overexpression** of miRNA results in underproduction of the associated protein.

miRNAs are involved in key biological processes such as **development, cell differentiation, proliferation**, and **apoptosis** (programmed cell death).

They help maintain **cellular homeostasis** and respond to environmental stimuli.

Alterations in miRNA expression contribute to diseases like **cancer, autoimmune disorders**, and other human conditions.

Circulating miRNAs are considered potential **biomarkers** for **diagnosis and prognosis** of various diseases due to their stability in human fluids.

Ambros and Ruvkun's Contribution:

Victor Ambros and Gary Ruvkun, both American biologists, made significant strides in understanding gene regulation while studying mutant strains of roundworms. They focused on two genes, *lin-4 and lin-14,* which were instrumental in revealing the **role of microRNA.** Their collaborative efforts led to the **discovery of microRNA** as a new principle of gene regulation. Published in 1993, their findings reshaped the scientific understanding of molecular biology.

Future Applications of MicroRNA

MicroRNA in Disease and Health MicroRNAs regulate entire gene networks**, impacting many physiological and pathological processes.** Researchers have discovered that **dysregulation of microRNA** contributes to the development of cancers and other diseases. For example, mutations in genes coding for microRNAs can cause conditions such as congenital hearing loss and skeletal disorders.

Role in Cancer Research Studies have shown that **abnormal microRNA regulation** plays a significant role in cancer development. Mutations in **microRNA-related proteins, like those causing DICER1 syndrome,** are associated with cancer across multiple tissues.

Potential Therapeutic Applications Understanding **microRNA's regulatory functions** offers potential therapeutic applications in gene therapy, targeted cancer treatments, and the diagnosis of genetic disorders. Researchers are now investigating how to manipulate microRNA pathways to treat diseases caused by gene dysregulation.

Nobel Prize Highlights the Role of MicroRNA in Gene Regulation and RNA's Central Role in Biology

Sub: Sci

Sec: Biotech

Why in News

Victor Ambros and Gary Ruvkun were recently awarded the **Nobel Prize in Physiology or Medicine** for their discovery of **microRNA (miRNA)** and its crucial role in gene regulation. This discovery has far-reaching implications for understanding cellular processes and potential therapeutic applications, particularly in diseases like cancer.

About MicroRNAs (miRNAs):

- They are small RNA molecules that regulate gene expression in **eukaryotes** by interfering with the **translation of mRNA into proteins.**
- The discovery began with experiments on **elegans**, a tiny roundworm, where researchers showed that gene regulation can happen **post-transcription**, challenging the previous understanding that it was solely the domain of transcription factors.
- By **2001**, microRNAs were found to be present in **invertebrates and vertebrates**, and many of them were **highly conserved across species**, indicating that microRNA-mediated regulation is a **universal mechanism**.
- MicroRNAs (miRNAs) are **small, non-coding RNA molecules,** approximately **21-24 nucleotides** in length, involved in regulating gene expression.
- miRNAs bind to **messenger RNA (mRNA)** in the cell cytoplasm to control gene expression.
- They either trigger the **degradation** of mRNA or prevent it from being translated into proteins, thereby regulating protein production.
- **Under expression** of miRNA can lead to overexpression of the protein it controls, while **overexpression** of miRNA results in underproduction of the associated protein.
- miRNAs are involved in key biological processes such as **development, cell differentiation, proliferation**, and **apoptosis** (programmed cell death).
- They help maintain **cellular homeostasis** and respond to environmental stimuli.
- Alterations in miRNA expression contribute to diseases like **cancer, autoimmune disorders**, and other human conditions.
- Circulating miRNAs are considered potential **biomarkers** for **diagnosis and prognosis** of various diseases due to their stability in human fluids.

The Role of MicroRNA in Gene Regulation

MicroRNAs (miRNAs) are **small RNA molecules,** typically **22 bases long,** that play a key role in post-transcriptional gene regulation.

They bind to **messenger RNA (mRNA)** and **prevent the synthesis of proteins by either degrading the mRNA or blocking its ability to serve as a template for protein production.**

miRNAs regulate **about 60% of all human genes**, influencing critical processes such as:

- **Cell differentiation**
- **Cell division**
- **Response to stress and disease**
- **Cell death**

Importance of RNA in Cellular Function

- Every cell contains **DNA**, which acts as the blueprint for producing **proteins**, the functional molecules of life.
- Each gene in the **DNA encodes a specific protein.** However, only the proteins required by a cell are produced, depending on the cell's type and function.
- When a cell needs to produce a protein, it creates a copy of the gene's instructions in the form of **mRNA** through a process called **transcription**.
- Once produced, **protein synthesis** continues until stopped by regulatory mechanisms like miRNA.

What is RNA?

- RNA (Ribonucleic Acid) is a single-stranded molecule composed of **ribose sugar, phosphate groups**, and **nucleotide bases** (adenine, guanine, cytosine, uracil).
- It plays a crucial role in various biological processes, mainly in **coding, decoding, regulation, and expression** of genes.

Types of RNA:

- **Messenger RNA (mRNA):** Carries genetic information from **DNA to the ribosome,** where proteins are synthesized.

- **Transfer RNA (tRNA):** Helps in **translating mRNA into proteins** by bringing amino acids to the ribosome during protein synthesis.
- **Ribosomal RNA (rRNA):** A structural **component of ribosomes,** essential for **protein synthesis.**
- **MicroRNA (miRNA):** Regulates **gene expression by binding to mRNA,** either degrading it or inhibiting its translation into protein.
- RNA plays a central role in the process of **transcription** (copying genetic code from DNA to RNA) and **translation** (using mRNA to build proteins).
- RNA is **single-stranded** (unlike double-stranded DNA).
- RNA contains **uracil** instead of thymine, which is found in DNA.
- RNA has a **ribose sugar** instead of deoxyribose found in DNA.
- **Gene regulation:** miRNA and other small RNAs control gene expression.
- **Catalytic activity:** Certain RNAs like ribozymes act as enzymes.
- **Messenger function:** mRNA acts as a template for protein synthesis.
- RNA-based technologies, such as **mRNA vaccines**, have become critical tools in developing treatments for diseases, including **COVID-19**.

How the microscopic worm C. elegans won 4 Nobel Prizes

Sub : Sci

Sec : Biotech

Context:

- **Victor Ambros and Gary Ruvkun** were recently awarded the **Nobel Prize in Physiology or Medicine** for their discovery of **microRNA (miRNA)** and its crucial role in gene regulation.
- In his Nobel Prize acceptance speech, Gary Ruvkun lauded the **tiny worm Caenorhabditis elegans (C. elegans),** emphasizing its significant contributions to scientific discovery.

Nobel prizes involving C. elegans:

- elegans has been involved in **four Nobel Prize-winning research projects**, highlighting its significant role in advancing our understanding of biology.
- **Understanding Cell Death:** *elegans* has contributed to understanding how healthy cells undergo **programmed cell death (apoptosis).** This research has provided crucial insights into various diseases, including AIDS, strokes, and degenerative diseases, and was recognized with the **Nobel Prize in 2002**.
- **Gene Silencing:** In 2006, researchers were awarded Nobel Prize for discovering gene silencing using *elegans*, leading to the development of a new class of therapeutic drugs.
- **Cellular Imaging Techniques:** The **2008 Chemistry Nobel Prize** acknowledged scientists who utilized *elegans* to invent **cellular lanterns**, which enhance the ability to observe cellular processes.
- **microRNA:** The 2024 Nobel Prize in Physiology or Medicine was awarded to Victor Ambros and Gary Ruvkun for their discovery of microRNA and its role in gene regulation.

About C. elegans:

- Caenorhabditis elegans is a free-living **transparent nematode about 1 mm in length** that lives in **temperate soil**
- **Life cycle**: Rapid development, with a **life cycle of about 3 days** from egg to adulthood.
- It is considered a model organism to study animal development and behaviour.

Unique Characteristics of C. elegans:

- **Simplicity:**
  - With **only 959 cells**, scientists find it manageable to study and understand fundamental biological concepts.
  - Each cell's fate has been meticulously mapped, and the **transparency** of the worms allows for easy observation of developmental stages.
  - It completes all its **developmental stages in about three days**.
- **Genomic Advances:**
  - In 1998, C. elegans became the first animal to have its **entire genome sequenced**, well ahead of other model organisms like fruit flies and mice.
  - The worm is inexpensive, easy to store and entirely self-sufficient in reproduction. Female C. elegans have functional sperm that allow them to inseminate themselves.

o Its **ease of cultivation and self-sufficiency in reproduction** make it an ideal model organism for laboratory studies.

Cooperation Among Scientists:

- The success of research involving C. elegans can be attributed to the **collaborative spirit among scientists** working with this model organism.
- Researchers often share resources and findings, which fosters innovation and progress.
- The C. elegans research community comes together every other year at the International Worm Convention.

Understanding the Long-Term Stability of Donor Stem Cells in Transplant Recipients

Sub : Sci

Sec : Biotech

Why in News

A recent study published in *Science Translational Medicine* has explored how **hematopoietic stem cells** from donors evolve over time after being transplanted into recipients. This research focuses on recipients who have survived for extended periods—some up to 46 years—offering critical insights into mutation rates and potential risks of clonal expansion.

What are Stem Cells?

A stem cell is a cell with the unique ability to **develop into specialized cell types in the body.** These cells provide **new cells for the body as it grows,** and **replace specialized cells** that are damaged or lost. In the future, they will be used to replace cells and tissues that have been damaged or lost due to disease.

About Hematopoietic Stem Cells:

- **Hematopoietic stem cells (HSCs) are multipotent stem cells** that are essential for the **production of all blood cell types,** including **red blood cells, white blood cells, and platelets.** These cells have the **unique ability to self-renew and differentiate,** ensuring the **continuous replenishment of blood cells throughout an individual's life.**
- **Primary Function**: HSCs are responsible for **generating and sustaining the entire blood cell system in the body.**
- **Location**: Primarily found in **bone marrow,** but also present in **umbilical cord blood** and, to a lesser extent, in **peripheral blood.**
- **Clinical Importance**: Hematopoietic stem cell transplants are a key treatment for conditions like **leukemia, lymphoma, and certain genetic blood disorders.**
- **Self-Renewal Capacity**: HSCs can divide to **produce new stem cells,** maintaining a **steady supply of blood cells.**
- **Differentiation Ability**: They can differentiate into **myeloid and lymphoid lineages,** leading to various blood cell types.
- **Role in Regenerative Medicine**: Due to their **regenerative capacity,** HSCs are central to therapies involving **blood cancers and immune system disorders.**
- **Significance for Blood Cancer Treatment**: Hematopoietic stem cell transplants are a **crucial treatment for blood cancers,** as they **restore the patient's ability to produce blood cells.**

About Duplex Sequencing:

- **Duplex Sequencing** is an advanced **DNA sequencing technique** designed to significantly **enhance accuracy** by identifying and **eliminating errors in DNA sequencing data.**
- Duplex sequencing offers **unparalleled accuracy by independently analysing both DNA strands** to eliminate errors, reducing false positives significantly.
- **Lowers sequencing errors** by up to 10,000 times **compared to traditional methods,** enhancing mutation detection accuracy.
- **Detects low-frequency mutations** and is sensitive enough for applications like **cancer research and monitoring residual disease.**
- Helps track mutation rates in studies involving **long-term genetic stability,** such as **hematopoietic stem cell transplants.**
- Useful in areas requiring **high precision,** such as **cancer diagnostics, evolutionary studies, and aging-related genetic research.**

The significance of India's mission to develop supercomputers

Sub : Sci

Sec: Awareness in AI & Computers

Context:

- Prime Minister Narendra Modi inaugurated **three PARAM Rudra supercomputers** on September 26, with a total investment of **Rs 130 crore.**
- These supercomputers are designed to provide advanced facilities to **India's scientific community,** supporting research across various fields including physics, cosmology, and earth sciences.

What is a Supercomputer?

- **Definition**: A large computing system designed for complex scientific and industrial challenges.
- **Purpose**: Handles time-consuming and computation-intensive tasks
- **Physical Structure**: Occupies large rooms with multiple racks containing computer nodes with many cores
    - **IBM Blue Gene P supercomputer** is one of the largest examples of parallel computing as of the year **2023**.
- **Applications**:
    - Quantum mechanics, Weapons research, Weather forecasting, Climate research, Oil and gas exploration, Molecular dynamics, Physical simulations, Data analytics, Big data processing

The National Supercomputing Mission (NSM)

- **Launch**: 2015
- **Goal**: Build a grid of **70 powerful supercomputing systems**
    - These supercomputers were later **networked** on the **National Supercomputing Grid** over the **National Knowledge Network (NKN)**.
- **Budget**: Rs 4,500 crores
- **Duration**: Seven years
- **Current Status**: Two phases complete, third phase ongoing

Key Stakeholders

- Department of Science and Technology (DST)
- Ministry of Electronics and Information Technology (MeitY)
- Centre for Development of Advanced Computing (CDAC)
- Indian Institute of Science (IISc), Bengaluru

Applications

- Climate and weather modeling, Aerospace engineering, Computational biology, Atomic energy simulations, National security and defence, Seismic analysis, Disaster management, Computational chemistry, Nanomaterials research, Astrophysics, Financial modeling

Achievements (2019-2023)

Technical Milestones

- **Total capacity: 24.83 petaFLOPS** High-Performance Computing (HPC) machines commissioned
- **Installation of multiple systems:**
    - 7 systems > 1 petaFLOPS
    - 8 systems: 500 teraFLOPS - 1 petaFLOPS
    - 13 systems: 50-500 teraFLOPS

Supercomputer	Institute	Capacity and memory
PARAM Shivay	IIT BHU	837 teraFLOPS and a total memory of 54.5 TB
PARAM Shakti	IIT Kharagpur	1.66 petaFLOPS and a total memory of 103.125 TB
PARAM Brahma	Indian Institute of Science Education and Research, Pune	1.75 petaFLOPS and a total memory of 56.8 TB
PARAM Yukti	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore	1.8 petaFLOPS and a total memory of 52.416 TB
PARAM Sanganak	IIT Kanpur	1.67 petaFLOPS and a total memory of 104.832 TB
PARAM Pravega	Indian Institute of Science, Bangalore	3.3 petaFLOPS and a total memory of 245.945 TB

PARAM Seva	IIT Hyderabad	838 teraFLOPS and a total memory of 52.416 TB
PARAM Smriti	National Agri-Food Biotechnology Institute, Mohali	838 teraFLOPS
PARAM Utkarsh	CDAC, Bangalore	838 teraFLOPS and a total memory of 52.416 TB
PARAM Ganga	IIT Roorkee	1.66 petaFLOPS and a total memory of 104.832 TB
PARAM Ananta	IIT Gandhinagar	838 teraFLOPS and a total memory of 52.416 TB
PARAM Porul	NIT, Trichy	838 teraFLOPS
PARAM Himalaya	IIT Mandi	838 teraFLOPS and a total memory of 52.416 TB
PARAM Kamrupa	IIT Guwahati	838 teraFLOPS and a total memory of 52.416 TB
PARAM Siddhi	AI CDAC, Pune	5.2 petaFLOPS and 210 petaFLOPS (AI)
PARAM Rudra	Giant Metrewave Radio Telescope, Pune	1 petaFLOPS
	Inter-University Accelerator Centre, Delhi	838 teraFLOPS
	SN Bose National Centre for Basic Sciences, Kolkata	838 teraFLOPS

Infrastructure Development

- **Operational R&D Systems**: SANGAM Testbed, PARAM Shrestha, PARAM Embryo, PARAM Neel, PARAM Spoorthi, PARAM Sampooran, Bioinformatics facility, System software lab

Human Resource Development:

- 1.75 lakh people trained in HPCs
- 5,930 experts from 100+ institutes utilized facilities
- 73.25 lakh high-performance computational queries executed
- Learning centers established at: IIT Kharagpur, IIT Palakkad, IIT Chennai, IIT Goa, CDAC, Pune

Historical Significance

- The **NSM** represents India's response to historical technology denials:
1. Space technology restrictions in the **1970s**
2. Supercomputer development barriers in the **1990s**
- These challenges motivated India to develop indigenous, cost-effective technologies, with the NSM emerging as a crucial tool for technological self-reliance and soft power projection.

Levitating Nanodiamonds: Pushing the Boundaries of Quantum Mechanics and Industrial Applications

Sub : Sci

Sec: Awareness in IT

Why in News

Physicists at Purdue University, USA, have successfully **levitated fluorescent nano diamonds (FNDs)** in a high vacuum, spinning them at extremely high speeds. This achievement marks a significant breakthrough, paving the way for potential advancements in fundamental physics and multiple industries, especially for quantum research and sensing technologies.

About Fluorescent Nanodiamonds (FNDs): They are **nanometre-sized diamonds** made **of carbon nanoparticles** produced under **high temperature and pressure.**

FNDs are non-toxic and stable under light, making them ideal for **biomedical applications** like cell tracking and high-resolution imaging.

They exhibit **long fluorescence lifespans** and do not blink under prolonged irradiation, unlike many other nanomaterials.

FNDs contain nitrogen-vacancy (NV) centers, which are vital for quantum computing and sensing technologies. FNDs are used in **microscale temperature sensing** and **correlative microscopy**.

Recent Breakthrough: Levitating and Spinning FNDs

In a recent study published in *Nature Communications,* physicists successfully **levitated FNDs in a high vacuum and spun them at ultra-high speeds**. This accomplishment opens the door for multiple industrial applications, particularly in **sensor technology.**

Industrial Applications of FNDs

FNDs are **highly sensitive to acceleration and electric fields,** making them ideal for use as sensors in various **high-value industries.**

The researchers suggest that the **Berry phase** generated by the **rotation of FNDs** could be useful in developing advanced **gyroscopes for rotation sensing.**

FNDs can be doped with elements like **nitrogen** to enhance their **electrical, magnetic, thermal**, and **optical properties.**

Doping creates **nitrogen vacancy (NV) centers,** which are key to the **electron spin qubits** in FNDs. These NV centers help in producing a macroscopic quantum superposition effect, which has implications for quantum computing.

About Carbon Nanoparticles

Carbon nanoparticles are nanoscale carbon materials with unique properties, including high surface area and electrical conductivity. Include **carbon black, fullerenes, carbon nanotubes (CNTs), and graphene.**

Used in **drug delivery, cancer therapy, energy storage (batteries), electronics, and environmental remediation.**

Biocompatibility, mechanical strength, and potential for targeted therapy in medical applications.

What is Quantum Spin?

It is an intrinsic property of particles like **electrons and nuclei,** analogous to angular momentum in classical physics.

Spin has two states: **up** and **down**, which are used in **quantum computing** to represent data as **qubits (0s and 1s).**

Spin is essential in **magnetic hard drives** and **quantum computing**, making it crucial for data storage and processing.

What is Berry Phase?

It is a **geometric phase acquired by a particle's wave function** when subjected to cyclic changes, discovered by **Michael Berry in 1986.**

It is crucial in **quantum mechanics** for understanding particle behavior in complex systems like **topological insulators**. The Berry Phase can be used in **quantum sensors** like **gyroscopes and accelerometers.**

NIC e-Office System Failure Halts Railway File Operations

Sub : Schemes

Sec: Awareness in IT

Why in News:

Recently, the **e-Office system used by the Indian Railways** experienced a major failure, causing file movements and communications within the department to come to a standstill for four to five days. This raised concerns about the **digital infrastructure's** resilience and the measures in place to handle such breakdowns.

About e-office:

E-Office is designed and **developed by National Informatics Centre**, **Ministry of Electronics & Information Technology (MEITY).**

E-Office is a **cloud enabled software** that can be deployed/hosted in any data centre or in any cloud identified by the organization.

NIC team shall help the organization in setting up of e-Office environment, master data preparation and in initial rollout.

The e-Office aims to support Governance by ushering in **more effective and transparent inter and Intra-Government processes.** The vision of e-Office is to achieve a simplified, responsive, effective and transparent working of all Government Offices.

The Open Architecture on which e-Office has been built, makes it a reusable framework and a standard reusable product amenable to replication across the Governments, at the Central, State and District levels.

e-office is for unclassified files with **two-factor authentication** and is not available on the Internet, but on NICNET. It has **mandatory features** of authentication of documents with **digitally signed certificates and e-signatures**. So far, 74 ministries and departments have migrated to e-office version 7.0.

Restoration by RailTel

RailTel, responsible for maintaining the **e-Office system for the Ministry of Railways,** restored normalcy after a few days of downtime.

The system is hosted in **Tier-III Uptime USA-certified data centres** in **Secunderabad** and **Gurugram** for RailTel customers, including the Indian Railways.

The exact reasons for the system failure were not disclosed, raising concerns over the **resilience and reliability** of the NIC e-Office system.

Besides the Indian Railways, the **NIC e-Office** platform also supports other government entities such as the **Employees Provident Fund Organisation (EPFO)**, **IRCTC**, and **Rail Vikas Nigam Limited (RVNL)**, indicating the broader impact such failures could have.

National Informatics Centre

The **National Informatics Centre (NIC) is an attached office under the Ministry of Electronics and Information Technology (MeitY)** in the Indian government.

It was established in **1976** and is located in **New Delhi.**

The NIC provides infrastructure to help support the **delivery of government IT services** and the delivery of some of the initiatives of **Digital India.**

NIC provides **network backbone and e-Governance support to the Central Government, State Governments and UT Administrations.**

NIC has been closely associated with the Government in different aspects of Governance besides establishing a **Nationwide State-of-the-Art information and communication technology (ICT) Infrastructure.**

It has also built a large number of digital solutions to support the government at various levels, making the last-mile delivery of government services to the citizens a reality.

Nobel Prize in Physics 2024: Recognizing Pioneers of Machine Learning with Neural Networks

Sub: Sci

Sec: Awareness in IT and Computer

Why in News

- The **2024 Nobel Prize in Physics** has been awarded to **John J. Hopfield of Princeton University, USA,** and **Geoffrey E. Hinton of the University of Toronto, Canada.** Their contributions to the field of **machine learning and artificial neural networks (ANN)** have laid the groundwork for modern advancements in **artificial intelligence (AI).** Their foundational discoveries have revolutionized areas like data processing, decision-making, and cognitive tasks, influencing various fields from physics to daily life applications.

John J. Hopfield and the Hopfield Network

- In 1982, Hopfield introduced a type of **recurrent neural network**, **now called the** *Hopfield network*, which models the **brain's associative memory system.** It is designed to process information and recognize patterns based on the strength of connections between neurons.

- The network's learning is based on the **Hebbian learning** principle, where **if one neuron consistently activates another, the connection between them strengthens.**

- Hopfield applied principles of statistical physics, such as energy minimization in magnetic systems, to explain how neural circuits could perform complex tasks. This was a significant leap in understanding the computational potential of simple neuron models.

Geoffrey E. Hinton and the Boltzmann Machine

- Hinton, building on the Hopfield network, adapted the **Boltzmann machine** to perform cognitive tasks. He later introduced the *Restricted Boltzmann Machine (RBM),* which became one of the first **deep learning**

- Hinton's work in the 2000s led to the creation of ANNs capable of **deep learning**, which allowed for the training of multiple layers of neurons to recognize patterns in complex data. This architecture has been instrumental in modern AI applications.

- Hinton's advances have been applied in **image recognition, natural language processing, medical diagnostics**, and more, with substantial success in fields such as physics, chemistry, and finance.

What is an Artificial Neural Network?

- Artificial Neural Networks (ANNs) are computing systems inspired by **biological neural networks in the brain,** designed to **simulate human cognitive functions like learning and problem-solving.**

- ANN is inspired by the **structure of the human brain, specifically its network of neurons.**

- **Neurons communicate through synapses, strengthening or weakening connections as new information is learned.** Similarly, ANN nodes simulate neurons by adjusting connection strengths based on data input.

- **ANNs learn by adjusting the strength of connections between nodes,** much like how the brain strengthens connections between neurons when learning new information. This allows the ANN to recognize patterns and make decisions without being explicitly programmed to follow specific instructions.

- The concept **originated in the 1940s** with early models like the **McCulloch-Pitts neuron model**.

- Significant advancements occurred in the **1980s when John Hopfield** introduced **Hopfield networks**, and **Geoffrey Hinton** developed **deep learning architectures in the 2000s.**

- **Structure**: ANNs consist of **layers of interconnected nodes (neurons).** Each node processes input data and passes it through activation functions to produce output. The system adapts by strengthening or weakening the connections (synapses) between nodes.
- ANNs learn by adjusting the weights of connections during training through algorithms like **backpropagation**, which minimizes errors between predicted and actual outcomes.

Types of ANN:

- **Feedforward Neural Networks**: Information flows in one direction, from input to output.
- **Recurrent Neural Networks (RNNs)**: Nodes form directed cycles, allowing data to flow in both directions, suitable for sequence prediction.
- **Convolutional Neural Networks (CNNs)**: Designed to process structured grid data like images, typically used in image and video recognition.
- **Hopfield Networks**: A type of recurrent network, used for associative memory and optimization problems.

Relation to Deep Learning:

- Deep learning is a subset of machine learning involving **multi-layered ANNs** (often more than three layers), enabling the model to learn complex patterns from vast datasets. Deep learning techniques, such as **Convolutional Neural Networks (CNNs)** and **Long Short-Term Memory (LSTM)** networks, are used for tasks like image classification and speech recognition.

Applications: ANNs are widely applied in:

- **Image and speech recognition** (e.g., facial recognition, voice assistants).
- **Natural language processing** (e.g., chatbots, translation tools).
- **Medical diagnostics** (e.g., identifying diseases in medical images).
- **Autonomous vehicles** (e.g., interpreting sensor data for navigation).
- **Finance** (e.g., stock market predictions and fraud detection).

Global Digital Compact: advancing digital innovation in a sustainable fashion

Sub :SCI

Sec: Awareness in IT

Global Digital Compact (GDC):

- The **Global Digital Compact (GDC)** is a **non-binding diplomatic instrument** focused on harnessing and **regulating digital technologies** for the **common good.**
- It outlines shared goals for governments, institutions, businesses, and other stakeholders, aiming for eventual soft law adoption.
- The GDC builds on previous UN-led compacts, such as the **Global Compact** (focused on sustainability) and the **Global Compact for Migration**.

Objectives and Framework:

- **Digital Technologies Impact**: The **GDC** acknowledges the transformative power of digital technologies and their potential to support **Sustainable Development Goals (SDGs)**, while also recognizing the challenges they pose.
- The GDC emphasizes **global cooperation** in digital governance, proposing panels on **AI governance** and **AI scientific study** to promote responsible digital development.
- **Key goals include:**
    - Closing the **digital divide**.
    - Ensuring **equitable data governance**.
    - Promoting **trustworthy technologies** in a free and competitive market.

Digital Public Goods and Infrastructure:

- The GDC proposes creating **digital public goods** like open-source software, open data, and AI models to drive social change and build **digital public infrastructure**.
- This infrastructure would involve partnerships with private entities to provide services through shared digital systems, focusing on public needs.

Challenges and Limitations:

1. **Limited Openness in Partnerships**:
    - Public-private partnerships in digital projects may limit openness due to **non-disclosure agreements** and **intellectual property protections**.

2. **Lack of New Internet Governance Frameworks**:
   o The GDC relies on **self-regulation by tech companies**, which has proven ineffective in the past.
3. **Interoperable Data Governance Risks**:
   o While promoting data sharing for AI innovation, the GDC doesn't adequately address the risks posed by insufficient personal data protection laws.
4. **Monopolistic Control**:
   o The GDC calls for involving corporations in data governance but doesn't outline measures to prevent monopolistic control over data and technology.

GDC's Position in Global Governance:

- The GDC aligns itself with the **UN's broader digital governance efforts** but offers little concrete guidance on pressing issues like **AI governance**.
- It promotes **"data flow with trust"**, which some countries resist due to concerns about **digital sovereignty** and **data localization.**
- The GDC links its objectives with the **SDGs**, reflecting a belief in the role of digitalization in achieving sustainable development. However, given the slow progress on SDG goals, there's skepticism about whether the GDC can create meaningful change.

Impact of Technological Advancements on Protein Studies: Insights from 2024 Chemistry Nobel Laureates

Sub : Sci

Sec: Awareness in IT and Computers

Why in News

The **2024 Nobel Prize in Chemistry** was jointly awarded to **David Baker**, **Demis Hassabis**, and **John Jumper** for their significant contributions to **protein research,** particularly in protein structure prediction and design. Their groundbreaking work has redefined our understanding of proteins, crucial to all life forms, and opened new possibilities in the field of biotechnology.

Importance of Proteins: Proteins are the fundamental building blocks of life. They are **composed of amino acids** and play key roles in various biological processes such as catalysis of biochemical reactions, structural support, molecular transport, muscle contraction, and cell communication.

About Proteins:

Proteins are **large, complex molecules made of amino acids** that perform vital **biological functions.**

Proteins are composed of **one or more long chains of amino acids linked by peptide bonds.**

Proteins have **four levels of structure—primary, secondary, tertiary, and quaternary—**dictating their shape and function.

Proteins are involved in structural support, catalyzing reactions (enzymes), transport, immune defense, and cellular signaling.

Common types include **enzymes, antibodies, structural proteins (e.g., collagen), and transport proteins (e.g., hemoglobin).**

Proper folding into a **specific 3D shape is crucial for their functionality; misfolding can cause diseases.**

Proteins are **synthesized in cells by ribosomes** through a process called **translation, using mRNA as a template.**

Proteins are **broken down into amino acids via proteolysis,** allowing the **body to recycle amino acids.**

Proteins are involved in **every cellular process,** from **DNA replication to cell structure maintenance.**

About Amino Acids:

Amino acids are the basic units that make up proteins. There are **20 standard amino acids** used to build proteins in humans and most organisms.

Each amino acid consists of an **amino group ($-NH_2$), a carboxyl group (-COOH), and a unique side chain (R-group).**

Out of the 20, **9 are essential and must be obtained through diet.** The remaining 11 amino acids can be synthesized by the body.

Amino acids are **linked together by peptide bonds to form proteins.** Amino acids play roles in **metabolism, enzyme function, and cell signalling.**

Amino acids are **encoded by the DNA sequence via codons in the genetic code.** Amino acids are crucial for **growth, repair, and maintaining body functions.**

The Protein-Folding Problem

What is Protein Folding? Protein folding refers to the **process by which a protein's amino acid chain acquires its specific three-dimensional structure, which determines its function.** The challenge lies in predicting this structure based on the amino acid sequence alone.

The **1962 Nobel Prize** was awarded for the elucidation of the **first 3D structures of proteins (hemoglobin and myoglobin) using X-ray crystallography.** This set the stage for modern protein research.

Breakthroughs in 1969: Scientists discovered that **proteins possess an inherent ability to fold themselves into the correct shape**—a phenomenon central to the **"protein-folding problem."**

AlphaFold: Revolutionizing Protein Structure Prediction

Co-founded by **Demis Hassabis**, DeepMind developed **AlphaFold**, a deep-learning **model capable of predicting the 3D structures of proteins with high accuracy.** By 2020, its predictions rivalled the precision of traditional X-ray crystallography.

What is AlphaFold?

AlphaFold is a revolutionary tool that **predicts the 3D structure of proteins,** developed by **DeepMind,** co-founded by **Demis Hassabis** in 2010 and acquired by Google in 2014.

AlphaFold 1 (2018): The original model could **predict the structure of almost any protein** based on known structures.

AlphaFold 2 (2020): Achieved accuracy comparable to X-ray crystallography in predicting protein structures.

AlphaFold 3 (2024): Led by **John Jumper,** this version expanded its capabilities to **predict interactions between proteins and between proteins and other molecules.**

AlphaFold is an **AI-based protein structure prediction tool**. It is based on a computer system **called deep neural network**. Inspired by the human brain**, neural networks use a large amount of input data and provides the desired output exactly like how a human brain would**.

The real work is done by **the black box between the input and the output layers, called the hidden networks**.

AlphaFold is **fed with protein sequences as input. When protein sequences enter through one end, the predicted three-dimensional structures come out through the other**. It is like a magician pulling a rabbit out of a hat.

How does AlphaFold work?

AlphaFold is an AI-based protein structure prediction tool. It used **processes based on "training, learning, retraining and relearning" to predict the structures of the entire 214 million unique protein** sequences deposited **in the Universal Protein Resource (UniProt) database.**

About Rosetta Program: In 2003, **David Baker** introduced the **Rosetta** software, used to **predict and design protein structures.** This tool has been widely adopted in computational biology.

Applications of Protein Design:

COVID-19 Antiviral Spray: In 2022, Baker's team designed an antiviral protein-based nasal spray that targets the spike protein of the COVID-19 virus.

Commercial Reactions: Baker's work also led to the design of new enzymes for industrially valuable chemical reactions, including those used to manufacture **atorvastatin** (a cholesterol-lowering drug) and **vitamin B6**.

2024 Physics Nobel Laureates: Pioneers of Artificial Neural Networks and Their Role in AI

Sub : Sci

Sec: Awareness in IT and Computers

Why in News

On October 8, 2024, **John Hopfield** and **Geoffrey Hinton** were awarded the **Nobel Prize in Physics for their ground breaking contributions to artificial neural networks (ANNs).** Their pioneering work has laid the foundation for modern machine learning technologies, playing a critical role in the development of Artificial Intelligence (AI).

What is an Artificial Neural Network?

Artificial Neural Networks (ANNs) are computing systems inspired by **biological neural networks in the brain,** designed to **simulate human cognitive functions like learning and problem-solving.**

ANN is inspired by the **structure of the human brain, specifically its network of neurons.**

Neurons communicate through synapses, strengthening or weakening connections as new information is learned. Similarly, ANN nodes simulate neurons by adjusting connection strengths based on data input.

ANNs learn by adjusting the strength of connections between nodes, much like how the brain strengthens connections between neurons when learning new information. This allows the ANN to recognize patterns and make decisions without being explicitly programmed to follow specific instructions.

The concept **originated in the 1940s** with early models like the **McCulloch-Pitts neuron model**.

Significant advancements occurred in the **1980s when John Hopfield** introduced **Hopfield networks**, and **Geoffrey Hinton** developed **deep learning architectures in the 2000s.**

Structure: ANNs consist of **layers of interconnected nodes (neurons).** Each node processes input data and passes it through activation functions to produce output. The system adapts by strengthening or weakening the connections (synapses) between nodes.

ANNs learn by adjusting the weights of connections during training through algorithms like **backpropagation**, which minimizes errors between predicted and actual outcomes.

Types of ANN:

Feedforward Neural Networks: Information flows in one direction, from input to output.

Recurrent Neural Networks (RNNs): Nodes form directed cycles, allowing data to flow in both directions, suitable for sequence prediction.

Convolutional Neural Networks (CNNs): Designed to process structured grid data like images, typically used in image and video recognition.

Hopfield Networks: A type of recurrent network, used for associative memory and optimization problems.

Relation to Deep Learning:

Deep learning is a subset of machine learning involving **multi-layered ANNs** (often more than three layers), enabling the model to learn complex patterns from vast datasets. Deep learning techniques, such as **Convolutional Neural Networks (CNNs)** and **Long Short-Term Memory (LSTM)** networks, are used for tasks like image classification and speech recognition.

Applications: ANNs are widely applied in:

Image and speech recognition (e.g., facial recognition, voice assistants).

Natural language processing (e.g., chatbots, translation tools).

Medical diagnostics (e.g., identifying diseases in medical images).

Autonomous vehicles (e.g., interpreting sensor data for navigation).

Finance (e.g., stock market predictions and fraud detection).

John J. Hopfield and the Hopfield Network

In 1982, Hopfield introduced a type of **recurrent neural network**, **now called the *Hopfield network*,** which models the **brain's associative memory system.** It is designed to process information and recognize patterns based on the strength of connections between neurons.

The network's learning is based on the **Hebbian learning** principle, where **if one neuron consistently activates another, the connection between them strengthens.**

Hopfield applied principles of statistical physics, such as energy minimization in magnetic systems, to explain how neural circuits could perform complex tasks. This was a significant leap in understanding the computational potential of simple neuron models.

Geoffrey E. Hinton and the Boltzmann Machine

Hinton, building on the Hopfield network, adapted the **Boltzmann machine** to perform cognitive tasks. He later introduced the *Restricted Boltzmann Machine (RBM),* which became one of the first **deep learning** networks.

Restricted Boltzmann Machines (RBMs) are a type of artificial neural network that is particularly useful in **unsupervised learning**. They are designed to discover patterns in data by modelling the underlying probability distribution.

Hinton's work in the 2000s led to the creation of ANNs capable of **deep learning**, which allowed for the training of multiple layers of neurons to recognize patterns in complex data. This architecture has been instrumental in modern AI applications.

Hinton's advances have been applied in **image recognition, natural language processing, medical diagnostics**, and more, with substantial success in fields such as physics, chemistry, and finance.

Centre Establishes Three AI Research Hubs in Health, Agriculture, and Sustainable Cities

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Why in News

The **Government of India** has announced the establishment of three **Centres of Excellence (CoEs) in Artificial Intelligence (AI),** focusing on **healthcare, agriculture, and sustainable urban development.** These CoEs are designed to drive innovation, create employment, and boost India's position in the global AI landscape.

Centres of Excellence (CoE) for Artificial Intelligence:

A **Centre of Excellence (CoE)** is an organizational framework designed to **foster research, development, and the application of advanced technologies** in specific fields like **Artificial Intelligence (AI).**

CoEs serve as hubs for **conducting cutting-edge research,** pushing the boundaries of knowledge in their respective fields, such as AI in healthcare, agriculture, or sustainable cities.

CoEs work closely with **industry players, startups, and academic institutions to bridge the gap between theoretical research and practical application,** ensuring that AI solutions are relevant and scalable.

CoEs focus on **nurturing high-quality talent through multidisciplinary training programs, creating a skilled workforce equipped with AI expertise** to meet industry and societal needs.

Three AI Centres of Excellence (CoEs) will focus on **healthcare, agriculture, and sustainable cities.**

Lead Institutions: **IIT Delhi** (healthcare), **IIT Ropar** (agriculture), and **IIT Kanpur** (sustainable cities) will lead these CoEs.

The CoEs will work in collaboration with industry partners and startups for interdisciplinary research and innovation.

Established under the vision **"Make AI in India, Make AI work for India,"** these CoEs aim to drive AI research and applications.

The initiative has a **budget of ₹990 crore, spanning FY 2023-24 to 2027-28.**

The CoEs will contribute to building India's AI talent, supporting startups, and generating job opportunities.

An apex committee, co-chaired by **Zoho founder-CEO Sridhar Vembu**, has been constituted to oversee the implementation and operations of the CoEs.

Objectives of the AI-CoEs:

Innovation: Develop AI-driven solutions for healthcare, agriculture, and sustainable urban development.

Job Creation: Generate employment opportunities by nurturing the start-up ecosystem.

Global Competitiveness: Strengthen India's position in the international AI landscape.

Multidisciplinary Research: Foster collaboration across sectors for optimal outcomes.

Leveraging AI and Genomics to Uncover Thousands of New Viruses

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Why in News

Recent advancements in **artificial intelligence (AI)** combined with **genomics** have led to the discovery of **thousands of new viruses.** Researchers are utilizing **deep learning methods** and **genome sequencing** to uncover **viral species,** enhancing our understanding of **viral diversity** and its impact on **public health.** These innovations mark a critical step forward in **pandemic preparedness.**

What Are Viruses?

- **Non-cellular entities** consisting of genetic material **(DNA or RNA)** enclosed in a protein coat called **capsid**.
- **Viruses rely on host cells for replication, making them obligate parasites.**
- **Lack ribosomes** and **energy-producing mechanisms, depending entirely on the host's cellular machinery** for **protein synthesis and energy.**
- **Exhibit immense diversity in structure, size, and composition.**

Structural Features of Viruses:

- **Genetic Material:** Can be **single- or double-stranded DNA/RNA**. Genome size varies from a few thousand bases to over a million.
- **Capsid: Protein coat** protecting viral genome, composed of capsomere subunits. Can exhibit **helical, icosahedral**, or **complex**
- **Envelope:** Some viruses possess a **lipid envelope** acquired from host cell membranes, aiding in immune evasion and cell entry.
- **Glycoprotein spikes** on the envelope (e.g., in influenza and HIV) help in attaching to host cells.

Virus Classification:

Based on Structure:

- **Helical:** e.g., Influenza virus.
- **Icosahedral:** e.g., Poliovirus.
- **Enveloped:** e.g., HIV, Coronavirus.
- **Complex:** e.g., Bacteriophages.

Based on Host Organism:

- **Animal Viruses**
- **Plant Viruses**
- **Bacteriophages** (infect bacteria).

Based on Nucleic Acid:

- **DNA Viruses:** e.g., Adenovirus, Herpesvirus.
- **RNA Viruses:** e.g., Picornavirus, Rhabdovirus.

Viral Reproduction Mechanisms:

Lytic Cycle:

- **Attachment:** Virus binds to host cell receptors.
- **Penetration:** Viral genome enters the cell.

- **Replication:** Virus hijacks host machinery to produce viral components.
- **Assembly:** New viral particles are assembled.
- **Release:** Host cell is lysed, releasing new viruses.

Lysogenic Cycle:

- Viral genome integrates into host DNA, remaining dormant as a **prophage**.
- May enter the **lytic cycle** later due to environmental triggers.
- Seen in latent infections like **herpes** or in **retroviruses** like HIV, where the viral genome integrates into host DNA.

The Ecological and Medical Significance of Viruses

Viruses are found everywhere—from soil and water to extreme environments like **hydrothermal vents.** Despite this, only a small fraction of the estimated **100 million to a trillion viral species** has been identified.

Viruses are increasingly recognized **not only as agents of disease but also as contributors to ecosystems.** However, their role in **emerging infectious diseases poses significant threats,** with studies estimating around **300,000 mammalian viruses yet to be discovered, many of which could have zoonotic potential (transmitting from animals to humans).**

Rise of Metagenomics in Viral Research:

The reduction in costs and improvements in **genome-sequencing technologies** have led to widespread **adoption of metagenomics.** This approach allows researchers to **analyse genetic material** from environmental samples directly, bypassing the need for **culturing.**

About Metagenomics:

Metagenomics is the study of genetic material recovered directly from environmental or clinical samples by a method called **sequencing**. The broad field may also be referred to as **environmental genomics, Eco genomics, community genomics** or **microbiomics.**

Metagenomics is the study of the structure and function of **entire nucleotide sequences** isolated and analysed from all the organisms (typically microbes) in a bulk sample. Metagenomics is often used to **study a specific community of microorganisms,** such as those residing on human skin, in the soil or in a water sample.

About Serratus: A Breakthrough Tool

In 2022, Canadian researchers led by **Artem Babaian developed Serratus,** an open-source tool that **matches sequencing data with known viral RNA-dependent RNA polymerase (RdRP) sequences.** With over 5.7 million sequencing libraries, **Serratus helped discover more than 100,000 new viruses.**

AI's Transformative Role in Viral Research

Traditional metagenomic approaches are limited as they **often miss evolved proteins**. However, recent studies **combining genomics with transformers** (a type of deep-learning model) have **revolutionized virus detection.**

Chinese researchers utilized a transformer, combined with genome-sequencing and the **ESMFold model,** to **analyse metagenomic data.** This resulted in the identification of over 160,000 new RNA viruses, with many species described for the first time from extreme environments like hot springs and salt lakes.

About ESM (Evolutionary Scale Modelling) Fold model:

It is a state-of-the-art deep learning model developed by **Meta AI** for predicting the **3D structures of proteins** based on their **amino acid sequences.** It is a **transformer-based model**, leveraging advancements in natural language processing (NLP) to understand protein sequences and predict their folding patterns.

ESM Fold has been shown to be **highly accurate in predicting protein structures,** rivalling other state-of-the-art methods like **AlphaFold** (developed by DeepMind).

U.S. National Security Memorandum on Artificial Intelligence: Framework for Safeguards and Strategic Edge

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Why in News

The **United States** has unveiled a **National Security Memorandum (NSM)** addressing **national security risks** associated with **artificial intelligence (AI).** This initiative follows **President Joe Biden's** executive order on **AI regulation,** highlighting the urgency of managing **technological advancements** while safeguarding public trust.

Main Aspects of the Memorandum:

- The **NSM emphasizes** the need for the **U.S. to maintain its technological edge over adversaries** like China, particularly in **military and intelligence contexts.**
- It calls for **collaboration with the private sector to enhance security measures** and ensure that **AI development** aligns with national interests.

- The memorandum urges the **development of international agreements to ensure AI systems are safe and trustworthy**.
- Agencies are directed to **prioritize AI in government supercomputers** and **emerging technology systems.**
- It outlines **steps to enhance the cybersecurity of AI systems,** highlighting the importance of **counterintelligence against espionage** targeting the **U.S. AI industry.**
- The **NSM reaffirms support for the National AI Research Resource program,** facilitating access to essential resources for AI research.

Other Recent Global Efforts to Regulate AI:

The **world's inaugural AI Safety Summit**, hosted at **Bletchley Park** in the UK, saw **28 major nations, including the US, China, Japan, the UK, France, India, and the European Union, unite in signing a declaration** emphasizing the necessity for **global action to address the potential perils of AI.**

The declaration **underscores the recognition of significant risks** stemming from potential deliberate **misuse and unintended control challenges** in advanced AI, particularly in **domains such as cybersecurity, biotechnology, and the spread of disinformation.**

In response to these concerns, the **US President issued an executive order** aiming to **fortify defences against AI-related threats and exercise regulatory oversight** over safety standards applied by companies in the assessment of **generative AI systems like ChatGPT and Google Bard.**

During the **G20 Leaders' Summit held in New Delhi,** the **Indian Prime Minister advocated for the creation of a global framework governing the development of "ethical" AI tools**.

This **shift in New Delhi's stance signifies a transition** from a position of **non-interference in AI regulation to a proactive approach, involving the formulation of regulations** grounded in a "risk-based, user-harm" perspective.

India's AI rush thrusts Nvidia to centre stage

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Context:

- **Reliance Industries** and **Nvidia** have announced a **collaboration** to build extensive **AI infrastructure in India**, supporting the booming demand for **AI services** and providing essential computing power to startups.
- **Nvidia's GPUs,** which lead the **AI hardware market** due to their unmatched performance, have made the company a major player with a market cap exceeding **$3 trillion, second only to Apple.**
- **Key Project**:
  - **Nvidia** will support **Reliance** in establishing a **1GW data centre** in **Jamnagar, Gujarat.** This facility will bolster **AI capabilities within India,** complemented by additional deployments of **Nvidia GPUs** across other Indian enterprises.

Other Major Deployments:

- **Tata Communications** is deploying **Nvidia Hopper GPUs** for **public cloud infrastructure** and plans to upgrade to **Nvidia's next-gen Blackwell GPUs** in **2025**.
- **Yotta Data Services** provides customers with **Nvidia's NIM** and **NIM Agent Blueprints** for AI applications, attracting clients like **Sarvam AI, Innoplexus,** and **Zoho.**
- **E2E Networks** operates across **India, the Middle East, and Asia-Pacific,** offering **high-performance Nvidia GPU-powered cloud services.**
- **Netweb** is expanding its **Tyrone AI systems** based on **Nvidia MGX architecture** to optimize enterprise data centre workloads.

Government Support and Domestic Computing Initiatives:

- The **Indian government** has launched a **Rs 10,370 crore AI Mission** to build local computing capacity and subsidize access for startups and researchers.
- Plans include a **public-private partnership** for developing **AI infrastructure,** with **Rs 4,564 crore** dedicated to creating **computing infrastructure** and a provision for scalability based on demand.

About graphics processing unit (GPU):

- A **GPU** is an **electronic circuit** designed for **high-speed mathematical computations,** crucial for applications like **graphics rendering, machine learning (ML),** and **video editing**.
- Unlike **central processing units (CPUs)** that handle multiple general tasks, **GPUs** excel in performing the same operation on numerous data values simultaneously, making them ideal for **compute-intensive tasks.**

Why GPUs Are Important?

- Originally, **GPUs** were developed **solely for controlling image displays.** However, advancements like **Nvidia's CUDA software** in **2007** enabled **general-purpose parallel processing on GPUs.**
- This made **GPUs** highly efficient for various tasks, especially those requiring substantial computing power, such as **AI, ML, and simulations.**
- Today, **GPUs** power a broad range of applications beyond graphics, including finance, defense, and research.

Key Evolution Milestones:
1. **Early Graphics Controllers**: Initially, non-programmable graphics controllers managed displays, heavily relying on CPUs.
2. **First GPUs**: The first GPU aimed at consumer markets emerged in the late 1990s for gaming and CAD. In 1999, Nvidia released the GeForce 256 GPU.
3. **CUDA Introduction**: In 2007, Nvidia's CUDA expanded GPU programming access, enabling use in AI, ML, and other compute-heavy applications.

Practical Applications:
1. **Gaming**: GPUs are critical for complex game rendering.
2. **Professional Visualization**: Used in CAD, medical imaging, and video editing.
3. **Machine Learning**: GPUs accelerate ML model training and can be accessed via cloud-based options for quicker results.
4. **Blockchain**: Many blockchains, especially those using proof-of-work models, rely on GPUs for transaction processing.
5. **Simulation**: Applied in areas like weather forecasting and vehicle design for high-fidelity simulations.

GPU Variants
- **Discrete GPUs**: Standalone chips dedicated to intensive tasks.
- **Integrated GPUs (iGPUs)**: Combined with CPUs on a single chip, commonly found in laptops and smartphones.
- **Virtual GPUs**: Software-based GPUs that enable cloud-based processing without physical hardware maintenance.

GPU vs. CPU:
- While **CPUs** manage **general system control and multitasking**, **GPUs** specialize in **repetitive, parallel tasks like ML.** This distinction makes **GPUs** better suited for tasks needing vast computational power, such as **real-time simulations** and **AI training models.**

GPU vs. Graphics Card:
- A **graphics card** is the **hardware** that **houses the GPU** along with components like **VRAM** and **cooling systems.** The **GPU** is the **core of this card,** performing the computational tasks, whereas the card itself connects to the motherboard to manage display functions.

PM cautions people against 'digital arrest' scam by fraudsters
Sub : Sci

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Context:
- Prime Minister Narendra Modi cautioned people against the **digital arrest scam** and asked them to report such cases to the **cyber helpline number 1930**.
- He also urged schools and colleges to involve students in the 'campaign to spread awareness of the menace.

What is digital arrest scam:
- This type of scam involves fraudsters **impersonating law enforcement officials** to defraud victims.
- Scammers typically initiate contact via phone or video calls, **posing as officials from law enforcement or financial institutions** like the Reserve Bank of India.
- The first step involves gathering personal information from victims.
- Then, scammers often **create a sense of urgency and fear** by presenting themselves in official uniforms and using government-like backgrounds and quoting legal provisions.
- They **threaten victims with arrest**, increasing the pressure to comply with their demands.

CERT-In advisory on online scams:
- Legitimate government agencies do not communicate via platforms like WhatsApp or Skype, indicating that such communications are likely fraudulent.
- Victims should be aware that no genuine law enforcement agency will pressure them to send money immediately.
- Confirm identity directly with relevant agencies if someone claims to be from law enforcement. Do not engage over video calls or transfer money.

- Never share sensitive details over the phone or video calls, especially with unknown numbers.
- Ensure websites use HTTPS before providing sensitive information.
- Only install apps from official app stores to avoid malware.

CERT-In shared a list of online scams:
- **Phishing Scams:** Scammers impersonate trusted organizations through emails/messages. Use urgent language (e.g., account suspension) to prompt immediate action, leading to counterfeit websites to capture credentials.
- **Lottery and Prize Scams:** Victims receive notifications claiming they've won a lottery, often requiring payment of processing fees to claim prizes.
- **Emotional Manipulation Scams:** Scammers create fake profiles on dating apps, building emotional connections before fabricating crises to solicit money, often via cryptocurrency.
- **Job Scams:** Fake job listings on job portals or social media, asking for application fees or training costs. **Red Flags:** Offers that seem too good to be true, especially requests for upfront payment.
- **Tech Support Scams:** Unsolicited calls from scammers claiming to be tech support, often guiding victims to grant remote access to their computers. **Consequences:** Theft of personal information, installation of malware, and unnecessary charges for software.
- **Investment Scams:** Promise unrealistic returns through schemes like Ponzi or pyramid schemes, often marketed via social media. Target individuals seeking quick financial solutions, exploiting financial illiteracy.
- **Cash-on-Delivery (CoD) Scams:** Fake online stores accepting CoD orders, delivering counterfeit or different products.
- **Fake Charity Appeal Scams:** Scammers create fake organizations to solicit donations for non-existent causes, exploiting compassion and urgency.
- **Mistaken Money Transfer Scams:** Scammers claim money has been mistakenly transferred to the victim's account, creating urgency to return funds.
- **Digital Arrest Scams:** Victims receive messages claiming they are under investigation, often accompanied by threats of arrest unless immediate payment is made.
- **Parcel Scams:** Victims are told their parcel has been seized for containing illegal items, pressured to pay fines.
- **Loan/Card Scams:** Advertise loans with low rates and quick approvals, often requiring upfront fees.

Computer Emergency Response Team – India (CERT-IN):
- It is an organisation of the Ministry of Electronics and Information Technology, Government of India, with the objective of securing Indian cyberspace.
- It is the nodal agency which deals with cybersecurity threats like hacking and phishing.
- It collects, analyses and disseminates information on cyber incidents, and also issues alert on cybersecurity incidents.

Beyond the Iron Dome: The many layers of Israel's air defence system

Sub : Sci

Sec: Defence

Context:
- On October 1, **Iran** launched a missile attack against **Israel,** which prompted Israel to announce retaliatory measures. While **Iran claimed successful strikes, Israel reported that their advanced air defence systems intercepted many incoming missiles.** This event highlighted the importance of **Israel's multi-layered missile defence strategy**.

Israel's Air Defense Systems:
- **Israel** maintains a sophisticated, multi-layered air defence network designed to counter various threats, from short-range rockets to long-range ballistic missiles.

System	Features

1. Iron Dome	- **Purpose**: Short-range air defense system
	- **Target**: Rockets, artillery, mortars, aircraft, helicopters, and drones
	- **Development**:
	    o Initiated after the **2006 Israeli-Lebanon war**
	    o Developed by **Rafael Advanced Systems** and **Israel Aerospace Industries**
	    o Deployed in **2011**
	- **Features**: Includes radar and interceptor missiles to track and neutralise incoming threats

2. David's Sling	- **Purpose**: Mid-range missile defense

	- **Range**: Intercepts missiles fired from **100-200 km** away
	- **Development**:
	   o Joint project between **Rafael** and **RTX Corp (formerly Raytheon)**
	   o Became operational in **2017**
	- **Key Features**:
	   o Uses **"Stunner" missile** with **hit-to-kill technology**
	   o No warhead - destroys threats through direct impact
	   o **92%** success rate against short-range ballistic missiles
	   o Features SkyCeptor variant for additional threats

3. Arrow System	- **Purpose**: Long-range missile defense
	- **Capability**: Can intercept missiles beyond Earth's atmosphere
	- **Developer**: Israel Aerospace Industries (IAI)
	- **Features**:
	   o Modular design
	   o Tracks and destroys incoming tactical ballistic missiles
	   o **Arrow 3** specifically designed for newest long-range threats
	   o Effective against weapons of mass destruction

4. Iron Beam	- **Purpose**: Short-range defense (up to **10 km**)
	- **Technology**: Laser-based system
	- **Developer**: Rafael Advanced Systems
	- **Advantages**:
	   o Speed-of-light engagement
	   o Unlimited ammunition capacity
	   o Nearly zero cost per interception
	   o Minimal collateral damage
	   o More cost-effective than traditional missile interceptors

CCS clears deals for MQ-9B drones and submarines

Sub : Sci

Sec: Defence

Context:

- The **Cabinet Committee on Security (CSS)** approved two high-profile deals for the purchase of 31 MQ-9B High Altitude Long Endurance Unmanned Aerial Vehicles from General Atomics of the U.S. and indigenous construction of two nuclear attack submarines.
- The purchase of 31 MQ-9B drones include 15 Sea Guardians for the Indian Navy and 16 Sky Guardians, 8 each for the navy and air force.
- Approval from CCS is the **final step** of the procurement deal.
- As part of the deal, General Atomics is scheduled to establish a Global **Maintenance, Repair and Overhaul (MRO)** facility in India.

Significance:

- Both MQ-9B drones and nuclear submarines are **'hunter-killer' weapon platforms** because they can quietly gather intelligence, track enemy targets at extended ranges and then destroy them if required.

About MQ-9B Predator Drones:

- The MQ-9B drone is a **variant of the MQ-9 "Reaper",** an unmanned aerial vehicle (UAV) capable of remotely controlled or autonomous flight operations.
- These are **high-altitude long-endurance** drones armed with strike missiles which can take out enemy targets with high accuracy.
- It was developed by **General Atomics Aeronautical Systems (GA-ASI),** primarily for the United States Air Force (USAF).

- The MQ-9B has **two variants - Sky Guardian and Sea Guardian.** The Indian Navy has been operating the MQ-9B Sea Guardian since 2020.

Features of MQ-9B:
- It can carry up to 5,670 kg and has a fuel capacity of 2,721 kg.
- The drone can operate at **over 40,000 feet**.
- The Predator also has a **maximum endurance of 40 hours**, making it useful for long-hour surveillance.
- It can support land, maritime surveillance, anti-submarine warfare, anti-surface warfare, strike, electronic warfare and expeditionary roles.
- It is also **capable of automatic take-offs and landings.**

Nuclear Submarine Project (SSN Project):
- The SSN project is a part of larger **Project 75-Alpha** (75-A) of the Indian Navy to procure new nuclear-powered attack submarines, which started in 2015.
- India has already indigenously manufactured nuclear-powered ballistic missile submarines (SSBN) and the SSN project will be a follow-on to that.
- **India's second SSBN, INS Arighaat**, was commissioned into service recently, joining INS Arihant, which was commissioned into service in 2016.
- SSNs provide **unlimited endurance**, with operational limits only determined by crew endurance.
- India has leased two SSNs from Russia; a third is expected to be operational in 2-3 years.

About Cabinet Committee on Security (CCS):
- The Cabinet Committee on Security (CCS) is a key decision-making body of the Indian government in matters of **national security and defence**.
- It is headed by the Prime Minister.
- **Members:**
    - Prime Minister
    - Minister of Defence
    - Minister of Home Affairs
    - Minister of Finance
    - Minister of External Affairs

US to send Israel THAAD missile defence system
Sub: Sci

Sec: Defence

Context:
- the **United States** will send a **Terminal High Altitude Area Defence battery (THAAD)** and troops to **Israel** amid its ongoing offensive against the Hezbollah.

Terminal High Altitude Area Defense (THAAD) system:
- **THAAD system** is an **advanced anti-ballistic missile defence system** developed by the **United States.**

Key Points about THAAD:
- **Developed by:** United States
- **Purpose:** THAAD is designed to shoot down **short, medium,** and **intermediate-range ballistic missiles** during their terminal phase of flight.
- **Operation:** It uses **hit-to-kill technology,** meaning it destroys incoming missiles by direct collision rather than using an explosive warhead.
- **Components:** The system consists of **five major components:**
    - Launchers
    - Interceptors
    - Radar
    - Fire control unit
    - Support equipment
- **Range:** THAAD can intercept missiles both inside and outside the Earth's atmosphere, at altitudes **up to 150 km.**
- **Deployment:** It's mobile and can be rapidly deployed to conflict zones.

- **International use:** While developed by the US, THAAD has been sold or deployed to several allies, including **South Korea, Israel,** and the **United Arab Emirates.**
- **Limitations:** While highly effective against ballistic missiles, **THAAD** is **not designed to counter cruise missiles or shorter-range rockets.**

What are 'dragon drones', the latest weapon being used in Russia-Ukraine war?

Sub :Sci

Sec: Defence

Context:

- A new weapon, nicknamed **"dragon drone,"** has emerged in the **Russia-Ukraine war.** Both sides have shared videos showing drones seemingly raining down fire.

What are Dragon Drones?

- Dragon drones release *thermite*—a mixture of **aluminium** and **iron oxide**, initially developed to weld railroad tracks.
- **Thermite** burns at an **extreme temperature** of **2,427°C.**
- Once **ignited** by an **electrical fuse**, it triggers a **self-sustaining reaction** that's tough to stop. It can **burn** through almost anything, including **clothes, trees,** and **military vehicles.** It can even **burn underwater.**
- On contact with humans, it can cause **severe burns**, even **damaging bones.**
- The combination of **thermite** with **drones** allows for **precise attacks** that bypass traditional defences, making them **highly effective** and **dangerous**.

Usage in the Russia-Ukraine War

- First used around September by **Ukrainian forces** to set fire to vegetation used by Russian troops as cover.
- Russia soon began deploying similar drones.

Has Thermite Been Used Before in War?

- **World War I**: **German** zeppelins dropped thermite-laden bombs.
- **World War II**: Both **Allied** and **Axis forces** used thermite in aerial bombing campaigns, with millions of thermite bombs dropped on Germany and Japan.
- **Thermite Hand Grenades**: Used during **WWII** to disable artillery pieces without causing an explosion.
- **Modern Use**: **Thermite** is often used by espionage agents and special operations teams due to its intense burn and lack of explosion.

Is Thermite Legal in Warfare?

- **Not Banned**: The use of **thermite** in war is **not prohibited** under **international law.**
- **Restrictions**: The *Convention on Certain Conventional Weapons* limits the use of incendiary weapons like **thermite** against civilians.
  - o **Indiscriminate Nature**: Thermite's potential to cause severe burns and respiratory injuries means its use is restricted to **military targets** under **Protocol III of the Convention.**

India Finalizes $3.5-Billion Deal with the U.S. for 31 MQ-9B Armed UAVs

Sub : Sci

Sec: defence

Why in News

India has finalized a **$3.5-billion deal with the United States for the procurement of 31 MQ-9B high-altitude, long-endurance (HALE) armed unmanned aerial vehicles (UAVs)** as part of enhancing its defense capabilities. This deal was approved by **the Cabinet Committee on Security** and is part of India's growing strategic ties with the U.S.

About MQ-9B UAV:

India is procuring **31 MQ-9B armed UAVs,** which include **15 Sea Guardians for the Indian Navy and 16 Sky Guardians—eight each for the Indian Army and Air Force.** The contract was signed under the Foreign Military Sales (FMS) program of the U.S., ensuring interoperability and maintenance standards.

The MQ-9B drone is a **variant of the MQ-9 "Reaper",** an unmanned aerial vehicle (UAV) capable of remotely controlled or autonomous flight operations.

These are **high-altitude long-endurance** drones armed with strike missiles which can take out enemy targets with high accuracy.

It was developed by **General Atomics Aeronautical Systems (GA-ASI),** primarily for the United States Air Force (USAF).

The MQ-9B has **two variants — SkyGuardian and its sibling SeaGuardian.**

The Indian Navy has been operating the MQ-9B Sea Guardian since 2020.

Features of MQ-9B:

It can carry up to **5,670 kg and has a fuel capacity of 2,721 kg.**

The drone can operate at over **40,000 feet.**

The Predator also has a **maximum endurance of 40 hours,** making it useful for long-hour surveillance.

It can support land, maritime surveillance, anti-submarine warfare, anti-surface warfare, strike, electronic warfare and expeditionary roles.

It is also **capable of automatic take-offs and landings.**

It can **safely integrate into civil airspace, enabling joint forces and civil authorities to deliver real-time situational awareness** anywhere in the maritime domain day or night.

Strategic Importance

The induction of **MQ-9B UAVs is set to significantly boost India's Intelligence, Surveillance, and Reconnaissance (ISR) capabilities,** particularly enhancing the Navy's ability to monitor vast oceanic regions, including the Indian Ocean. These UAVs will help in reducing the wear and tear on the Navy's existing P-8I long-range maritime patrol aircraft.

Tri-Service Integration: The UAVs will be deployed across **all three Indian services—Army, Navy, and Air Force— augmenting joint operations** and enhancing the strategic surveillance and defense posture of the country.

Other aspects of the Deal:

Two major contracts were signed: one with the U.S. government for the UAV systems, and another with General Atomics Global India Pvt Ltd for performance-based logistics, ensuring the maintenance, repair, and overhaul (MRO) of these UAVs in India.

Missiles and Weapons Package: The deal also includes the supply of 170 AGM-114R Hellfire missiles, 16 M36E9 Hellfire captive air training missiles, 310 GBU-39B/B laser-guided Small Diameter Bombs (SDB), and 8 GBU-39B/B LSDB guided test vehicles with live fuses.

India Launches Its Fourth Nuclear Submarine with Advanced Ballistic Capabilities

Sub: Sci

Sec: Defence

Why in News

India recently launched its **fourth nuclear-powered ballistic missile submarine (SSBN), named S4*,** at the **Ship Building Centre (SBC) in Visakhapatnam.** This development marks a significant advancement in India's undersea nuclear deterrence capabilities.

Launch of INS Aridhman (S4*):

- India's **fourth SSBN, the S4*,** was launched into water at the **SBC in Visakhapatnam.**
- It has **significant indigenous content,** showcasing the involvement of Indian industry in its construction.
- It has a submerged displacement of around **7,000 tons,** which is larger than its **predecessor, INS Arihant,** and allows for the inclusion of advanced systems.
- The submarine will carry the **K-4 submarine-launched ballistic missile (SLBM)** with a **range of 3,500 km,** crucial for **India's undersea nuclear deterrence.**
- The **S4* forms a key part of India's nuclear triad,** enabling **second-strike capability from underwater,** significantly boosting India's strategic defence posture.
- It is one of the latest in a line of **advanced SSBNs under construction,** with plans to **eventually integrate the K-5 SLBM,** extending the strike **range to 5,000 km**

Current Operational SSBNs

India has two operational SSBNs:

1. **INS Arihant** (S2): Commissioned in **August 2016.**
2. **INS Arighaat** (S3): Commissioned in **late August 2024.**

About SSBN (Ship Submersible Ballistic Nuclear) -

Its primary role is to serve as a **strategic deterrent** by providing **second-strike capability,** ensuring a nation can retaliate with **nuclear weapons even after a nuclear attack.** SSBNs can **remain submerged for extended periods,** making them harder to detect and adding to their effectiveness as part of a country's nuclear triad.

Commissioned in **2016, INS Arihant** is India's **nuclear-powered ballistic missile-capable submarine,** classified under the **SSBN programme.**

The **SSBN** is a **hull classification symbol** for **nuclear-powered ballistic missile-carrying submarines.**

The **SSBN** are under the purview of India's Strategic Forces Command.

The family of indigenously developed **Submarine Launched Ballistic Missiles (SLBMs)**, sometimes referred to as **K family missiles** are **code-named** after **Dr A P J Abdul Kalam,** a key figure in India's missile and space programmes who also served as the **11th President** of India.

It is said that more members of the **K-family** with higher ranges are also on the cards. Launched in **2009, INS Arihant** was commissioned in **2016.**

About INS Arihant (S2):

It has a **displacement of 6,000 tonnes** and is **powered by an 83 MW pressurised light-water reactor with enriched uranium.**

Retains the **same reactor and dimensions, but has several technological upgrades**.

The **advanced technology project began in the 1980s** and its first product, the Arihant vessel, was **launched in 2009** by then-**Prime Minister Dr. Manmohan Singh, and eventually commissioned in 2016.**

The **third of these submarines, which is at an advanced stage of construction, is set to be larger and more capable than the current two submarines in the same class.**

About INS Arighaat (S3):

- INS Arighaat is a **6,000-tonne Arihant-class ballistic missile submarine**.
- Arighaat will be armed with **indigenously built K-15 missiles**, with a range of more than700km.
- It can reach a speed of 12–15 knots (22–28 km/h) on the surface and up to **24 knots (44 km/h) when submerged**.
- It is powered by **83 MW pressurised light-water nuclear reactors**, which allow it to remain **submerged and undetected for much longer** than conventional diesel-electric submarines.
- Compared to Arihant, the **indigenisation content has doubled** in Arighaat (from 30% to 60%)
- INS Arighaat will enhance the Navy's **nuclear strike capability and** will serve as a **vital component** of India's **nuclear triad**.
- Arighaat adds to India's sea-based nuclear deterrent, which is the most credible and survivable leg of the nuclear triad.

All about C295 aircraft, whose manufacturing plant was inaugurated by PM Modi
Sub : Sci

Sec: Defence

Context:

- On October 29, Prime Minister Narendra Modi inaugurated a plant in Vadodara, where **Tata Advanced Systems Ltd (TASL)** will manufacture the **C-295 aircrafts** for the Indian Air Force (IAF).
- The facility will be the **first private sector final assembly line for military aircraft** in India.
- The C-295 project underscores India's commitment to enhancing its **indigenous defence manufacturing** capabilities and aligns with the Make in India initiative.

Procurement Details:

- In September 2021, India signed a deal worth ₹21,935 crore with Airbus Defence and Space to procure **56 C-295 aircrafts,** aiming to **replace the IAF's aging Avro-748 planes**, which have been in service since the 1960s.
- The first 16 aircraft will be delivered in **fly-away condition** from Spain, while the remaining 40 will be manufactured in India by TASL.
- The first domestically produced aircraft is expected to roll out in September 2026, with all 39 to be delivered by August 2031.
- After the completion of the delivery, Airbus Defence and Space will be allowed to sell the aircraft manufactured in India to civil operators and export to countries which are cleared by the Government of India.
- **Fly-away condition:** A term used in aircraft purchase agreements, to refer to an aircraft that is delivered in new condition and in compliance with the purchase agreement.

About C-295 aircraft:

- The C-295 aircraft was originally produced by the Spanish manufacturer **Construcciones Aeronáuticas SA**, which is now part of Airbus. The aircraft is currently manufactured at Airbus's plant in Spain.
- The C-295MW is a versatile **transport aircraft** with a **capacity of 5 to 10 tonnes** and a **maximum speed of 480 km/h**.
- The C-295 has demonstrated its versatility by operating in various terrains globally, including Brazilian jungles and Colombian mountains, deserts of Algeria and Jordan and cold climates of Poland and Finland.

Key features:

- A rear ramp door for quick troop and cargo deployment.
- Capability for short take-off and landing from semi-prepared surfaces.

- Cabin dimensions of 12.7 meters, accommodating up to 71 seats.
- The aircraft will be fitted with an indigenous electronic warfare suite developed by Bharat Electronics Ltd and Bharat Dynamics Limited.

Operational roles:

- Tactical transport of troops and supplies to forward operating airfields.
- Short take-off and landing operations from unprepared airstrips.
- Casualty and medical evacuation.
- Special missions and disaster response.
- Maritime patrol duties.

Delay in GE's F-404 Engine Deliveries for LCA-Mk1A Sparks Penalty Clause Activation

Sub: Sci

Sec: Defence

Why in News

General Electric (GE) is expected to deliver **F-404 jet engines** for **India's Light Combat Aircraft (LCA) Mk1A** by March or April 2025 after extended delays. The delay has resulted in India invoking a **penalty clause** due to contractually overdue delivery timelines. The engines are crucial to powering India's indigenous fighter aircraft fleet under the **$716-million deal with Hindustan Aeronautics Limited (HAL).**

About the F404 Engine:

Produced by **GE Aerospace,** the **F404 is a reliable**, afterburning **turbofan engine** designed primarily for **military use.**

Originally developed to power the **Boeing F/A-18 Hornet,** it has since become adaptable for various aircraft and roles.

Engine Variants:

- **F404-GE-IN20**: Used in **India's Light Combat Aircraft (LCA) Tejas Mk1A,** this variant provides approximately 19,000 pounds of thrust and includes advanced Full Authority Digital Electronic Control (FADEC) for enhanced reliability.
- **F404-GE-103**: Powers the Boeing T-7A Red Hawk trainer, designed for the U.S. Air Force.
- **F404-RM12**: A variant co-developed with Volvo Aero specifically for the Saab Gripen fighter jet.
- **F404-GE-402**: Enhanced for fuel efficiency, this variant powers F/A-18 Hornet models.

The F404 engine series delivers high performance with **thrust levels between 10,500 and 19,000 pounds,** depending on the model, supporting both **high-altitude interception and low-altitude attack missions.**

The **F404 series includes single-crystal turbine blades** and high-temperature materials, improving the engine's heat resistance and overall durability.

About India's Light Combat Aircraft (LCA) Mk1A:

The LCA Mk1A is a **fourth-generation, single-engine, multi-role light fighter aircraft,** designed and developed by **Hindustan Aeronautics Limited (HAL)** under the **"Tejas" program in India.**

Created for the **Indian Air Force (IAF),** the **LCA Mk1A** focuses on **air defence, close air support, and reconnaissance missions,** complementing heavier fighters like the Su-30MKI.

Specifications:

- **Weight**: The maximum take-off weight (MTOW) is about 13.5 tons.
- **Engine**: Powered by the GE F404-IN20 engine, providing around 19,000 pounds of thrust, optimized for agility and speed.
- **Range**: It has a combat range of about 500 kilometres (km) and a ferry range of up to 1,750 km.
- **Speed**: Maximum speed is approximately Mach 1.6 (around 1,975 km/h).
- **Service Ceiling**: The aircraft can reach altitudes of up to 52,500 feet.

Avionics: The Mk1A features **modern avionics with a fully digital, fly-by-wire flight control system and advanced radar,** including **Active Electronically Scanned Array (AESA) radar.**

Equipped to carry **beyond-visual-range (BVR) missiles, air-to-surface missiles, laser-guided bombs, and advanced electronic warfare (EW) systems.**

The **Mk1A's low weight and high thrust-to-weight ratio enhance its manoeuvrability,** making it suitable for both offensive and defensive operations.

Designed with **minimal radar cross-section (RCS)** to enhance **survivability.**

Enhances India's airpower by **replacing aging fleets** such as the **MiG-21.**

About the Penalty Clause:

The penalty clause in **defence contracts** is a provision that **imposes financial or legal penalties** on contractors if they **fail to meet specific contractual obligations,** such as delivery timelines, performance standards, or technical specifications.

It serves as a **safeguard,** ensuring that delays or **non-compliance** do not compromise **critical defence projects** and that the contractor remains accountable.

In the context of the **LCA Mk1A, General Electric (GE)** was contracted to supply F404 engines to Hindustan Aeronautics Limited (HAL), the lead manufacturer of the LCA Mk1A.

Due to logistical issues, GE has faced delays in delivering these engines, which has affected the production timeline for the LCA Mk1A.

Given the delay, HAL has invoked the penalty clause against GE as per the contractual terms. This clause is typically triggered when delays or other violations exceed an acceptable or pre-defined limit set in the agreement.

Financial penalties may include a **percentage of the contract value deducted per day, week, or month of delay, based on the severity and impact of the delay.**

BRCA Testing and Breast Cancer Prevention: A Public Health Imperative

Sub: Sci

Sec: Health

Why in News

October is recognized as **Breast Cancer Awareness Month**, bringing attention to the importance of **BRCA testing** for identifying **hereditary breast and ovarian cancer risks.** The case of **Angelina Jolie** and her preventive surgeries has spotlighted the potential of **genetic testing to prevent cancer,** highlighting the need for widespread access and awareness.

What is Breast Cancer?

Breast cancer is a disease in which **cells in the breast grow out of control.** There are different kinds of breast cancer. The kind of breast cancer depends on which **cells in the breast turn into cancer.**

Breast cancer can **spread outside the breast through blood vessels and lymph vessels.** When breast cancer spreads to other parts of the body, it is said to have **metastasized.**

The common kinds of breast cancer are—

Invasive ductal carcinoma: The cancer cells begin in the **ducts and then grow outside the ducts into other parts of the breast tissue.** Invasive cancer cells can also spread, or metastasize, to other parts of the body.

Invasive lobular carcinoma: Cancer cells **begin in the lobules and then spread from the lobules to the breast tissues** that are close by. These invasive cancer cells can also spread to other parts of the body.

Causes of Breast cancer

Breast cancer **is not a transmissible or infectious disease.** Unlike some cancers that have infection-related causes, such as **human papillomavirus (HPV) infection** and cervical cancer, there are no known viral or bacterial infections linked to the development of breast cancer.

Certain factors increase the risk of breast cancer including **increasing age, obesity, harmful use of alcohol, family history of breast cancer, history of radiation exposure, reproductive history** (such as age that menstrual periods began and age at first pregnancy), **tobacco use** and **postmenopausal hormone therapy.**

Understanding Hereditary Breast and Ovarian Cancer (HBOC)

Hereditary Cancer: Occurs when an individual inherits mutations in cancer-causing genes. **BRCA1 and BRCA2 mutations** are the most well-studied, causing **Hereditary Breast and Ovarian Cancer (HBOC).**

The **BRCA gene** *(BRCA stands for BReast CAncer gene)* refers to two genes, **BRCA1 and BRCA2**, which play a **crucial role in suppressing tumors by repairing DNA damage.** Mutations in these genes can impair their ability to repair DNA, leading to an increased risk of several cancers, particularly **breast** and **ovarian cancers**.

Germline Mutations: These mutations **predispose individuals to multiple cancers**, including breast, ovarian, prostate, pancreatic, and gastric cancers.

Women with **BRCA mutations** face a **69-72% risk of breast cancer** and a **17-44% risk of ovarian cancer** by age 80. This is significantly higher compared to the general population's lifetime risks of **12% for breast cancer** and **1% for ovarian cancer**.

Preventive Measures: Options like **prophylactic mastectomy and oophorectomy** can reduce the risk of developing cancer by **90-100%** and significantly lower cancer-related deaths.

The Need for Population-Based Testing in India

Advances in **next-generation DNA sequencing** and genomics make large-scale population testing possible. However, India faces challenges in implementing this model due to the high costs of testing.

Next-Generation Sequencing (NGS): It is a modern DNA sequencing technology that has revolutionized genomic research by allowing the sequencing of DNA and RNA much more quickly and cheaply than the previously used **Sanger sequencing.**

The concept of a **liquid biopsy** is a revolutionary technique that offers a less invasive alternative to surgery.

Advantages of NGS:

Speed: Enables **rapid sequencing of large amounts of DNA/RNA.**

Cost-Effective: Lower cost per base compared to traditional sequencing methods.

Comprehensive: Can detect a **wide range of genetic variations,** including SNPs, insertions, deletions, and structural variations.

Scalability: Can be scaled to fit a variety of experimental needs, from small targeted studies to large genome-wide analyses.

Combatting Sickle Cell Disease

Sub: Sci

Sec: Health

Why in News

Sickle Cell Disease (SCD), a genetic disorder that significantly reduces life expectancy and causes severe complications, continues to pose a challenge in India. Recent reports from **rural Maharashtra** have highlighted remarkable efforts in managing the disease, offering hope and relief to patients in marginalized communities.

About Sickle Cell Disease (SCD):

Sickle Cell Disease (SCD) is an **inherited haemoglobin disorder** characterised by a **genetic mutation** that **causes red blood cells (RBCs)** to assume a **sickle** or **crescent shape** rather than their **normal round shape**.

This **abnormality** in **RBCs** results in **increased rigidity, impairing their ability to circulate effectively throughout the body.** Consequently, **individuals with SCD** often experience complications such as **anaemia, organ damage, recurrent and severe pain episodes**, and a **shortened lifespan**.

Sickle cell disease is a **common monogenic disorder** of **haemoglobin**.

India has the **highest prevalence** of **SCD** in **South Asia,** with over **20 million** affected individuals.

As per the **Ministry of Health and Family Welfare, marginalised tribal populations** are **most vulnerable to SCD.**

Symptoms: Symptoms of sickle cell disease can vary, but some common symptoms are-

Chronic anaemia which leads to fatigue, weakness, and paleness.

Painful episodes (also known as sickle cell crisis) cause sudden and intense pain in the bones, chest, back, arms, and legs.

Delayed growth and puberty.

Treatment Processes:

Blood Transfusions: These can help relieve anaemia and reduce the risk of pain crises.

Hydroxyurea: This medication can help reduce the frequency of painful episodes and prevent some of the disease's long-term complications.

Gene Therapy: It can also be treated by bone marrow or stem cell transplantation by methods like **Clustered regularly interspaced short palindromic repeats (CRISPR).**

What is Sickle Cell Disease (SCD)?
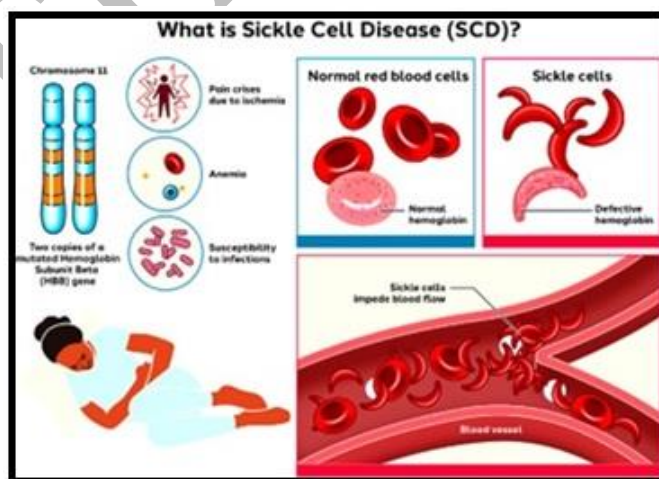
National Mission to Eliminate SCD 2047:

There is a need for a **paediatric formulation of hydroxyurea** in line with the **National Mission to eliminate SCD** by **2047.**

Under the **Sickle Cell Anaemia Mission,** the **Council of Scientific and Industrial Research (CSIR)** is developing **gene-editing therapies for SCD.**

Stem Cell Therapy as a Potential Cure for Type 1 Diabetes: The Indian Perspective

Sub: Sci

Sec: Health

Why in News

The recent success of a **woman in China,** who regained her insulin production after receiving stem cell therapy for **Type 1 diabetes (T1D),** has garnered global attention. This breakthrough, which involved the **transplantation of reprogrammed stem cells,** has the potential to revolutionize diabetes treatment, offering hope for millions living with this condition.

About Type 1 diabetes:

An absolute lack of insulin, usually due to destruction of the **insulin-producing beta cells of the pancreas, is the main problem in type 1 diabetes.**

It is to be due to an **autoimmune process, in which the body's immune system mistakenly targets its own tissues.**

This tendency for the immune system to destroy **the beta cells of the pancreas is likely to be**, **at least in part, genetically inherited,** although the exact reasons that this process happens are not fully understood.

Insulin Dependence: This leads to a lifelong dependence on externally administered insulin to manage blood sugar levels.

In contrast, **type 2 diabetes** occurs when the insulin produced by the body is either insufficient or ineffective. It is generally managed with oral medication and, in some cases, insulin therapy.

Difference Between Type 1 and Type 2 Diabetes

Criteria	Type 1 Diabetes (T1D)	Type 2 Diabetes (T2D)
Cause	Autoimmune disorder where the immune system destroys **insulin-producing beta cells** in the pancreas.	Insulin resistance or **insufficient insulin production** by the body.
Onset	Typically develops in childhood or adolescence.	Usually develops in adulthood, often linked to lifestyle factors.
Insulin Dependence	Patients are **insulin-dependent** for life as the body cannot produce insulin.	May not initially require insulin; managed with **oral medications and lifestyle changes,** though insulin may be needed in later stages.
Prevalence	Less common, accounting for **about 5-10% of all diabetes cases.**	More common, accounting for about **90-95% of all diabetes cases.**

Stem Cell Therapy:

Stem cell therapy falls under the category of **regenerative medicine** and offers a novel approach for curing **T1D.**

The therapy utilizes **pluripotent stem cells,** which have the **ability to transform into any cell type.** These stem cells are pre-programmed to become insulin-producing beta cells and are transplanted into the human body.

Restoration of Insulin Production: Once inside the body, these cells begin producing insulin, potentially eliminating the need for lifelong insulin injections.

A significant breakthrough occurred when a woman with **T1D in China** had her insulin production restored through stem cell therapy. This marks the **first successful regeneration of insulin-producing cells** through stem cell transplantation.

Types of Stem Cells Used

Embryonic Stem Cells (ESC): Derived from **early-stage embryos,** ESCs have the ability to differentiate into **insulin-producing beta cells.** Controversies surrounding the ethical use of embryos make this a debated source of stem cells.

Induced Pluripotent Stem Cells (iPSCs): Adult cells that are **genetically reprogrammed** to revert to a **pluripotent state** and then transformed into **insulin-producing cells**. iPSCs offer a less controversial and more ethically acceptable alternative to ESCs.

WHO Approves First Mpox Diagnostic Test for Emergency Use: Expanding Global Access

Sub : Sci

Sec: Health

Why In News

The **World Health Organization (WHO)** recently approved the **first Mpox diagnostic test** under its **Emergency Use Listing (EUL),** which is crucial for expanding diagnostic capacity and tackling the spread of the virus in Africa and other affected regions. This approval marks a significant step in improving access to accurate and timely testing, especially in countries grappling with Mpox outbreaks.

WHO's First Emergency Use-Listed Mpox Diagnostic Test

The WHO has approved **Alinity m MPXV assay**, developed by **Abbott Molecular Inc**, as the first Mpox in vitro diagnostic test under the Emergency Use Listing (EUL) procedure. This real-time PCR test is designed to detect **monkeypox virus (clade I/II) DNA from human skin lesion swabs**, ensuring rapid and precise diagnosis.

In 2024, Africa reported over **30,000 suspected cases** of Mpox. Limited testing capacity in the region has contributed to the virus's spread, delaying diagnosis and containment efforts.

How Alinity m MPXV assay works?

Detects **monkeypox virus (clade I/II) DNA from skin lesion swabs.** Uses **polymerase chain reaction (PCR)** for precise **virus identification.**

Provides quick confirmation of Mpox in suspected cases. Designed for trained clinical personnel in PCR techniques.

Approved by **WHO under the Emergency Use Listing (EUL)** to address Mpox outbreaks.

What is Mpox?

Mpox is a **viral zoonotic disease** caused by the monkeypox virus which was **first recorded in humans in 1970 in the Democratic Republic of the Congo (DRC).**

Mpox can be transmitted to humans through physical contact with someone who is infectious, with contaminated materials, or with infected animals.

There are **no specific treatments** for Mpox virus infection.

In 2022, the disease was declared a **global emergency** after it spread to some 70 countries. The emergency was withdrawn in 2023.

There are **two known types (clades) of mpox virus**: clade I and clade II

Clade I:

Severity: Clade I is considered the **more severe and deadlier variant.**

Transmission: This clade is **typically transmitted from animals to humans**, which is known as **zoonotic transmission.**

Geographical Distribution: Historically, **Clade I have been more common in Central Africa**, where human-to-animal interaction is higher.

Clade II:

Subdivisions: Clade II is further divided into **Clade IIa** and **Clade IIb**.

Clade IIb is the newer variant responsible for the **recent global outbreak.**

Transmission: This clade is more **transmissible between humans**, and it has been linked to **human-to-human transmission**, including through close contact and sexual activity.

Affected Groups: Clade IIb has **affected more women and children in Africa** and is spreading faster than previous variants.

Anti-cancer drugs to sport QR codes to check fakes
Sub: Sci

Sec: Health

Context:

- Due to concerns over counterfeit anti-cancer drugs, the government is considering to make it mandatory to **attach quick response (QR) codes to every vial and strip of medication** sold in India.

Details:

- The proposal came at a recent meeting of the **Drugs Technical Advisory Board (DTAB)**.
- This is aimed at ensuring a rigorous track-and-trace mechanism.
- An amendment to **Schedule H2 of the Drugs Rules, 1945** was also proposed, to **include all anti-cancer medicines**.
- This would make it mandatory to print or affix bar codes or quick response codes in the labels of these medicines.

Issue of counterfeit drugs:

- Criminals, in collusion with hospital pharmacies are **refilling empty vials of expensive anti-cancer medications** with counterfeit drugs.
- These fake drugs are **mixed with genuine stocks** and sold to patients, jeopardizing their health.

Schedule H2 of the Drugs Rules, 1945:

- Schedule H2 includes specific categories of drugs that are considered higher risk, often related to critical conditions like cancer.
- Under Schedule H2, the chemist cannot dispense the medicine unless he keeps a copy of the prescription with themselves, keeping proof of dispensing the drug.
- This puts an onus on the retailer that the drug dispensed is genuine.

Drugs Technical Advisory Board (DTAB):
- Advisory body to the Indian government on technical matters related to the Drugs and Cosmetics Act.
- It advises the central government on matters related to the **approval, quality control, and safety of pharmaceuticals**.
- Part of the Central Drugs Standard Control Organisation (CDSCO) under the Health Ministry.

Two months on, Meghalaya polio case shrouded in secrecy
Sub : Sci

Sec: Health

Background:
- In 2017, the Indian government faced criticism for covering up Zika virus cases.
- Recently, there has been hesitance in disclosing details about a polio case detected in Meghalaya.
- Also, officials have gave conflicting statements about the case, raising concerns about the management and reporting of public health information in India.

Vaccine-derived polio:
- Vaccine-derived poliovirus is a strain of poliovirus mutated from the strain originally contained in Oral Polio vaccine.
- OPV contains a **live, weakened form of poliovirus** that replicates in the intestine for a limited period, thereby developing immunity by building up antibodies.
- In rare cases, when replicating in the gastrointestinal tract, OPV strains can genetically change and may spread in **communities that are not fully vaccinated against polio**, especially in areas where there is **poor hygiene, poor sanitation, or overcrowding**.

Type of Vaccine-derived polio:
- **Immunodeficiency related vaccine-derived poliovirus (iVDPV):**
  - In the case of iVDPV, polio is caused in an **immune deficient** individual.
  - Unlike the general population, these individuals can shed the weakened virus for extended periods, creating a risk for transmission.
- **Circulating vaccine-derived polio (cVDVP):**
  - cVDPV is a strain of poliovirus that arises from the weakened virus used in the OPV.
  - It has mutated and regained the ability to cause disease and can circulate among **unvaccinated or under-vaccinated populations**.

Ultrasound-Based Technique: A Revolutionary Approach to Cancer Detection
Sub: Sci

Sec: Health

Why in News

Scientists are pioneering a **novel ultrasound-based method to detect cancers,** which could potentially replace invasive **biopsy procedures.** This groundbreaking technique, which was recently presented at the joint meeting of the **Acoustical Society of America and the Canadian Acoustical Association,** holds immense promise for transforming cancer diagnostics.

Ultrasound-Based Cancer Detection

A new, **non-invasive method** has been developed using **high-frequency ultrasound to detect cancerous tissues.** This technology enables scientists to **release tiny droplets containing RNA, DNA, and proteins into the bloodstream,** allowing them to **identify specific cancer biomarkers.**

How it Works:

High-energy ultrasound waves break off small pieces of tissue from **suspected cancerous areas.**

The tissue fragments release **genetic material and proteins (biomarkers) into the blood,** which can be tested for cancer detection.

Ultrasound increases the concentration of these biomarkers in the bloodstream by over 100 times, improving the chances of identifying cancer at an early stage.

Photoacoustic Imaging: New technology allows for **real-time imaging** of cancerous tissues using **laser pulses that create sound waves,** improving visualization of tumour-associated blood vessels. The new systems capture images **100 to 1,000 times faster** than previous technologies, enhancing clinical applicability

Wearable Ultrasound Devices: Researchers have developed a **miniaturized ultrasound scanner** that can be worn, enabling women to conduct breast imaging at home. This device can detect tumours as small as 0.3 cm, potentially increasing early detection rates for interval cancers

Benefits of Ultrasound Technology: Ultrasound is **non-invasive and radiation-free,** providing detailed soft tissue images, which is crucial for **detecting breast and prostate cancers.** The technology enhances surgical precision by differentiating between cancerous and healthy tissues during operations

Future Prospects: The **U.S. National Cancer Institute** has launched a new initiative, the **'Cancer Screening Research Network,'** which aims to explore innovative cancer detection techniques. The network is expected to begin large-scale clinical trials with **24,000 participants in 2025,** and this **ultrasound-based method** could be part of future trials.

About Cancer: Cancer is a disease characterized by the **uncontrolled growth and spread of abnormal cells within the body.** It can arise in various tissues and organs, leading to the formation of tumours.

Cancer begins with **genetic mutations** that alter the normal behaviour of cells. These mutations can result in the **proliferation of cancerous cells, forming clusters known as tumours.**

The **cancerous cells may detach from these tumours and spread through the lymphatic system or bloodstream,** leading to **metastasis** in other body regions.

Approximately **63% of all deaths in India** are attributed to NCDs, with cancer being a significant contributor.

By **2030**, the economic burden of cancer-related illnesses is projected to reach approximately **$3.55 trillion** in lost output.

India has eliminated trachoma, says WHO

Sub: Sci

Sec: Health

Context:

- WHO has now recognised that India has successfully eliminated trachoma, a bacterial infection that affects the eyes, as a public health problem.
- India is the third country in the Southeast Asia Region to reach this public health milestone.

About Trachoma:

- Trachoma is a disease of the eye caused by infection with the **bacterium Chlamydia trachomatis**.
- It is a **public health problem in 42 countries**, and is responsible for the blindness or visual impairment of about 1.9 million people.
- Blindness from trachoma is **irreversible**.
- **Prevalence**: in areas with poor sanitation and limited access to clean water.
- **Transmission**: Spread through **direct contact** with infected eye secretions ((via hands, clothes, bedding or hard surfaces)) or by **flies** that have come into contact with those secretions.

Symptoms

- Initial symptoms include **mild irritation and redness of the eyes, sensitivity to light, and discharge**.
- It can progress **to scarring of the eyelids (trichiasis) and corneal damage**, resulting in blindness if untreated.

SAFE Strategy:

WHO recommends the SAFE strategy to combat trachoma.

- **Surgery:** For those with advanced disease (trichiasis).
- **Antibiotics:** To treat active infections.
- **Facial cleanliness:** Promoting hygiene practices to reduce transmission.
- **Environmental improvements:** Improving access to clean water and sanitation.

Australia and New Zealand brace for looming bird flu threat

Sub: Sci

Sec: Health

Context:

- Australia and New Zealand are on high alert for the potential arrival of a destructive strain of H5N1 avian influenza, known as **clade 2.3.4.4b**, which has devastated bird and mammal populations globally since its emergence in 2020.
- To prepare for the impending threat, both countries have intensified biosecurity measures.

About clade 2.3.4.4b:

- Clade 2.3.4.4b is a highly contagious variant of H5N1 **virus**.
- This strain has resulted in the deaths of hundreds of millions of birds and tens of thousands of mammals, particularly in Asia, Europe, and Africa.

- The virus has recently reached **Indonesia and Antarctica**, increasing the threat level for Oceania, which remains the last region free from this avian influenza strain.

Increased risk during Spring:

- The risk of the virus entering Australia is particularly pronounced during the **spring months in Southern Hemisphere,** from September to November, when **migratory shore birds are active**.

Avian Influenza or Bird Flu:

- Avian influenza (AI) is a highly contagious **viral disease** affecting **several species of food-producing birds** (chickens, turkeys, quails, guinea fowl, etc.), as well as pet birds and wild birds.
- Occasionally mammals, including humans, may contract avian influenza.
- H5N1 is a **subtype** of the avian influenza virus.

Mode of transmission:

- Avian influenza is most often spread by contact between infected and healthy birds, though can also be spread indirectly through contaminated equipment.
- The virus is found in secretions from the nostrils, mouth, and eyes of infected birds as well as their droppings.

Govt okays universal supply of fortified rice till December 2028; concerns regarding indiscriminate supply without health warnings remain

Sub : Sci

Sec: Health

Context:

- The Centre has approved the continuation of **universal fortified rice distribution** under all Union government schemes, including **Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY),** from July 2024 to December 2028.
- Rice fortification will remain fully funded by the central government as part of PMGKAY.

What is Rice Fortification?

- **Fortification** is the process of adding essential **micronutrients** to food (rice, in this case) to improve its nutritional quality.
- **Nutrients** added to rice include **iron, folic acid, vitamins B-12, B-1, B-2, B-3, B-6, zinc,** and **vitamin A.**

Why Rice Fortification?

- **India** is the **second-largest producer and consumer of rice,** accounting for **20%** of global production.
- A third of the Indian population depends on **rice** for sustenance.
- **Malnutrition rates** in **India** are **high**, with **half of the women anaemic** and **one-third of children stunted.**
- **Fortifying rice** is seen as a measure to combat this issue, especially in poor communities where rice consumption is high (6.8 kg per capita per month).

Concerns Over Fortification:

- **Health Risks**:
  - **Fortified rice** may pose **health risks** to people with **blood disorders** like **thalassemia** and **sickle cell disease**, as consuming excess iron can cause complications such as organ failure.
  - Both the **Food Safety and Standards (Fortification of Foods) Regulation, 2018** and global research highlight the need for medical supervision for such patients.
  - **Fortified products** carry warnings for individuals with these conditions, but the **Food Safety and Standards Authority of India (FSSAI)** has proposed removing these warning labels, sparking concern.
- **Supreme Court Intervention**:
  - In **October 2023,** the **Supreme Court** directed the Centre to address concerns about the indiscriminate distribution of **iron-fortified rice** to those suffering from **thalassemia** and **sickle cell disease.**

Is Fortification Necessary?

- Evidence suggests **iron deficiency** is not universal and does not require a mandatory, widespread solution.
- Critics argue that **fortification** is not the only solution and stress the need for dietary diversification. The National Institute of Nutrition (NIN) recommends that less than 40% of daily calories should come from cereals, including rice.

Alternative Solutions:

- There is a call for long-term, sustainable solutions focused on dietary diversity rather than a one-size-fits-all approach like fortification.
- Community involvement and local dietary diversification are emphasized as better solutions to address malnutrition.

Why deaths occur due to heat stroke

Sub : Sci

Sec: Health

Context:

- The recent airshow in Chennai, resulting in five fatalities and numerous cases of heat-related illnesses highlighted the dangers of prolonged heat exposure.

What is a heat stroke:

- Heat stroke, also known as sun-stroke is a condition caused by excess heat in the body.
- This usually happens because of exposure to high temperatures or physical activity in high temperatures for too long.
- Heat stroke occurs when your **body gets overheated** (body temperature of 40°C or above) and **cannot cool itself down**.
- **Symptoms**: severe headache, dizziness, nausea and confusion. In some cases, it can cause seizures, or coma and can be fatal.

Factors influencing heat retention:

- According to the World Health Organisation, the **amount of heat stored in the body** is determined by a combination of two factors:
    1. an **inability to eliminate internally generated heat** from metabolic processes due to environmental health stress (such as high temperature, high humidity)
    2. **clothing creating a barrier to heat loss** and external heat gain from the environment.
- When the body can't control its temperature and get rid of extra heat, it raises the chances of heat stroke.

How does heat impact health:

- **Normal metabolic activity** occurs at **38 to 39 degrees Celsius**, and overheating can trigger dizziness and excessive sweating.
- Excessive sweating can lead to dehydration, thickening the blood and complicating circulation.
- This may result in **decreased blood pressure** and oxygen saturation levels, heightening the risk of serious health issues.

Effects of dehydration:

- Dehydration can increase sodium concentration, leading to **hypernatremia**, which may cause brain haemorrhages.
- Potential impacts on metabolism, affecting sodium, potassium, and fluid balance, leading to encephalopathy.

Vulnerable Population:

- Elderly people are particularly susceptible to heat stroke due to thinner skin and a higher likelihood of dehydration.
- Pre-existing health conditions can exacerbate the effects of heat exposure.

The Rise of AI-Generated Synthetic Medical Images: New Frontier or Potential Pitfall?

Sub: Sci

Sec: Health

Why in News

The growing use of **synthetic medical images,** generated by **artificial intelligence (AI),** has sparked significant interest in healthcare and research. These images offer a scalable, cost-effective solution to the challenge of acquiring high-quality medical images while maintaining patient privacy. However, concerns are emerging about the ethical implications and potential risks associated with this technology, making it a key topic in the ongoing AI revolution in healthcare.

What are Synthetic Medical Images?

Synthetic medical images are **AI-generated visuals created without traditional imaging methods like MRI, CT scans, or X-rays.** AI techniques such as **Generative Adversarial Networks (GANs), diffusion models, and autoencoders** are employed to construct these images from scratch, using **mathematical models** instead of real-world patient data.

These images serve as **alternatives to real medical images,** addressing the growing demand for annotated medical data in research and diagnostics.

How Synthetic Medical Images are Created:

Variational Autoencoders (VAEs): Compress **real images into simpler forms** and recreate them, improving image quality over time.

Generative Adversarial Networks (GANs): A **generator** creates synthetic images, while a **discriminator** distinguishes **between real and fake images,** leading to continuous improvement through competition.

Diffusion Models: Create **realistic images** using a step-by-step **refinement process.**

Advantages of Synthetic Medical Images:

Transforms data from one modality to another, such as **creating synthetic CT scans from MRI data,** filling gaps when certain types of scans are unavailable.

Privacy Protection: Since synthetic images do not rely on actual patient data, they help **avoid privacy concerns,** allowing easier sharing and collaboration across research teams without risking patient confidentiality.

Cost and Time Efficiency: Synthetic images **reduce the time and expense of collecting real medical data,** making research more efficient.

Challenges and Ethical Concerns:

Deepfakes in Healthcare: There is a risk that **synthetic images could be manipulated to create fake clinical findings** or submit fraudulent claims to insurers, posing financial and ethical risks.

Simplified Representations: Synthetic images may **fail to capture subtle yet crucial variations found in real medical data, such as tissue density differences in MRI scans,** reducing the diagnostic accuracy of AI models trained on synthetic data.

Overreliance on Synthetic Data: If AI systems rely predominantly on synthetic images, there is a **risk of creating diagnostic models that are disconnected from real-world medical complexities,** potentially leading to inaccurate diagnoses.

What is Generative Artificial Intelligence?

GAI is a rapidly growing branch of AI that focuses on **generating new content** (such as images, audio, text, etc.) based on patterns and rules learned from data.

The rise of GAI can be attributed to the development of **advanced generative models, such as Generative Adversarial Networks** (GANs) and **Variational Autoencoders (VAEs).**

These models are trained on large amounts of data and are able to **generate new outputs** that are similar to the training data. For example, a GAN trained on images of faces can generate new, synthetic images of faces that look realistic.

While GAI is often associated with **ChatGPT and deep fakes**, the technology was initially used to automate the repetitive processes used in digital image correction and digital audio correction.

Arguably, because machine learning and deep learning are inherently focused on generative processes, they can be considered types of GAI, too.

OpenSAFELY: A Game-Changer in Health Data Transparency and Privacy

Sub: Sci

Sec: Health

Why in News

The **OpenSAFELY platform,** developed by **Ben Goldacre and his team at the University of Oxford,** has revolutionized access to health data in the U.K. by **ensuring privacy while offering a transparent system for researchers.** This system is particularly significant for studying COVID-19-related data and other health conditions, creating a balance between public health research and patient privacy.

About OpenSAFELY:

OpenSAFELY is a **secure, transparent, open-source software platform** for analysis of **electronic health records data.** All platform activity is **publicly logged.** All code for data management and analysis is shared, under **open licenses and by default, for scientific review and efficient re-use.**

OpenSAFELY is a set of best practices encoded as software. It can be deployed to create a **Trusted Research Environment (TRE)** alongside appropriate database, compute, governance, and administrative elements; or it can be deployed as a privacy-enhancing layer on any existing secure database or TRE.

OpenSAFELY provides access to health records of **58 million U.K. citizens** without compromising individual privacy.

Researchers do not directly access raw health data. Instead, they use dummy datasets to test queries before being sent to secure systems for retrieval of necessary data, preventing unauthorized access.

How Does OpenSAFELY Ensure Transparency?

Open Code Sharing: Every **line of code** used by researchers is **immediately made publicly available,** ensuring **transparency** in research methodology.

Prevention of p-hacking: The **platform eliminates the risk of manipulating data to achieve desired results.** This transparency avoids the issue of different analysts producing varying results from the same dataset.

P-hacking refers to **manipulating data analysis to produce statistically significant results,** often by repeatedly testing variables until achieving a low p-value, leading to potentially false or misleading conclusions.

About National Health Service (NHS):

The **NHS was established in 1948** as a **publicly funded healthcare system in the U.K.,** providing healthcare free at the point of delivery. It offers comprehensive healthcare services to all U.K. residents, funded **primarily through taxation.**

Every **British citizen has a single health record maintained by the NHS**, containing **lifelong health information** from birth to death. Since 1996, 96% of NHS general practices have maintained electronic health records, aiding in healthcare efficiency and research.

NHS health data is used for research and analysis, with platforms like **OpenSAFELY** ensuring privacy and transparency.

About Indian National Digital Health Mission (NDHM):

Under National Digital Health Mission, every Indian will get a **Health ID card** that will **store all medical details of the person** including prescriptions, treatment, diagnostic reports and discharge summaries.

The citizens will be able to **give their doctors and health providers one-time access to this data** during visits to the hospital for consultation. However, access to the confidential medical data will have to be given separately for each visit due to fears over data confidentiality.

The National Digital Health Mission will allow patients to **access health services remotely through tele-consultation and e-pharmacies**, as well as offer other health-related benefits

It comes under the **Ayushman Bharat Pradhan Mantri Jan ArogyaYojana** (AB PM-JAY) and implemented by **National Health Authority.**

The **National Health Policy 2017 had envisaged creation of a digital health technology eco-system** aiming at developing an integrated health information system that serves the needs of all stakeholders and improves efficiency, transparency and citizens' experience with linkage across public and private healthcare.

In the context of this, central government's think-tank **NitiAayog, in June 2018**, floated a consultation of a digital backbone for India's health system — **National Health Stack**.

Emergency contraceptive pills need no prescription

Sub: Sci

Sec: Health

Context:

- The **Central Drugs Standard Control Organisation (CDSCO)** has denied recent claims suggesting a shift of **Emergency Contraceptive Pills (ECPs)** from over-the-counter status to prescription-only.
- There has been no change in the sales and distribution status of ECP brands like I-Pill and Unwanted-72. These pills remain available over the counter.

Importance of ECPs:

- Emergency contraceptive pills are vital for preventing unwanted pregnancies, **effective when taken within 72 hours** of unprotected intercourse.
- According to the **National Family and Health Survey-5 (2019-2021), 57% of women acquire ECPs over the counter**.

Regulation of Other Contraceptive Drugs:

- Currently, drugs such as **Centchroman and Ethinyloestradiol** fall under **Schedule 'H'** of the Drugs Rules, requiring a doctor's prescription for sale.
- Manufacturers must label these drugs with a caution statement indicating they can **only be sold with a prescription** from a registered medical practitioner.
- However, **certain strengths of contraceptive drugs**, including **specific combinations** of DL-Norgestrel, Levonorgestrel, and Ethinyloestradiol, are categorized under **Schedule K.** This means that these **particular strengths do not require a doctor's prescription** for purchase.

Role of CDSCO:

- The CDSCO operates under the **Health Ministry** and is responsible for regulating pharmaceuticals, cosmetics, and medical devices in India.
- Its duties include drug approval, clinical trial oversight, standard-setting, quality control of imports, and coordination with state drug control organizations.

Advancing Precision Medicine in India: The Need for Biobank Regulations

Sub : Sci

Sec : Health

Why in News

India's push for precision medicine is facing a significant hurdle due to the **lack of comprehensive biobank regulations.** While biobanks play a critical role in medical research, especially in advancing precision medicine, India's inconsistent regulations may impede progress and limit the benefits for society.

About Precision/personalised Medicine:

Precision medicine is an emerging approach for disease treatment and prevention that takes into **account individual variability in genes, environment, and lifestyle for each person.**

Precision medicine, also known as personalized medicine, is a new frontier for healthcare **combining genomics, big data analytics, and population health.**

This approach will **allow doctors and researchers to predict more accurately which treatment and prevention strategies for a particular disease will work in which groups of people.**

It is in **contrast to a one-size-fits-all approach**, in which disease treatment and prevention strategies are developed for the average person, with less consideration for the differences between individuals.

The field gained momentum following the **Human Genome Project** and has since played a pivotal role in diagnosing and treating cancers, chronic diseases, and cardiovascular and immunological disorders.

Emerging technologies like **gene editing**, **mRNA therapeutics**, and **organ-on-chips** are revolutionizing precision medicine, making it possible to target specific genetic mutations.

India's **precision medicine market** is growing at a **Compound Annual Growth Rate (CAGR)** of 16% and is expected to exceed **$5 billion by 2030**.

Precision medicine accounts for **36% of the national bioeconomy**, alongside **cancer immunotherapy**, **gene editing**, and other biotechnologies.

The Role of Biobanks in Precision Medicine

A **biobank** is a repository of **biological samples, such as blood, DNA, cells, and tissues,** along with their genetic data.

These samples are collected from consenting individuals and are crucial for research, particularly in **precision medicine**.

Biobanks must be **large and diverse** to ensure that the findings benefit all sections of society, not just a small group.

Biobanks aim to support studies on disease progression, treatment, and the development of new medical solutions. They play a vital role in understanding genetic predispositions and the impact of environmental factors on health.

Types:

- **Population-based biobanks**: Store samples from large groups, often for studying population health trends.
- **Disease-specific biobanks**: Focus on particular illnesses like cancer or cardiovascular diseases.

Relevance to SDGs: Biobanks contribute to **SDG 3 (Good Health and Well-being)** by supporting research that can lead to the discovery of new treatments and improved health outcomes globally

Regulatory Challenges for Biobanks in India

Unlike countries like the **U.K., U.S., Japan**, and **China**, which have robust biobank regulations, **India's biobanking laws are inconsistent**, with gaps in **informed consent**, **privacy**, and **data protection**.

Currently, there is no law in India that protects the rights of individuals donating biological samples to biobanks.

The **Indian Council for Medical Research (ICMR)** guidelines and **Department of Biotechnology (DBT)** protocols lack clarity on **data storage**, **access rights**, and **long-term use of samples**.

Individuals are often asked to provide consent without knowing how their genetic data will be used or who will access it.

Issues in the treatment of 'rare diseases', and what the govt can do
Sub : Sci

Sec :Health

Context:

- Recently, the Delhi High Court provided directives to enhance the availability of **orphan drugs**, which are medications designed for treating **rare diseases**.

About Rare Diseases:

- According to WHO, rare diseases are debilitating, lifelong conditions affecting 1 or fewer people per 1,000.
- Around 55 medical conditions including **Gaucher's disease, Lysosomal Storage Disorders** (LSDs), and certain forms of muscular dystrophy are classified as rare diseases in India.
- The **National Registry for Rare and Other Inherited Disorders (NRROID)** started by the **Indian Council of Medical Research (ICMR)** has the records of 14,472 rare disease patients in the country.
- Therapies are available for less than 5% of rare diseases, leading to less than **1 in 10 patients receiving disease-specific care**.

Categories of Rare Diseases:

In India, rare diseases are categorised into three groups based on the nature and complexity of available treatment options.

- **Group 1**: Curable with one-time procedures.
- **Group 2**: Require long-term, less costly treatment; documented benefits.
- **Group 3**: Effective but expensive treatments, often lifelong.

Current Funding Policy:

- **National Policy for Rare Diseases (NPRD)**: Launched in 2021.Provides financial assistance up to ₹50 lakh for treatment at identified Centres of Excellence (CoEs).
- **Centres of Excellence**: Include AIIMS (Delhi), PGIMER (Chandigarh), and SSKM Hospital (Kolkata).
- **Crowdfunding Portal**: Launched for patient treatment support and donations.

Challenges in Treatment:

- **Lack of Awareness**: Limited knowledge among healthcare providers and the general public.
- **High Treatment Costs**: Many treatments are expensive, leading to financial burden on families.
- **Limited Research**: Insufficient investment in research and development for rare diseases due to small patient populations.
- **Regulatory Hurdles**: Complex approval processes for new drugs and therapies.

Cost of orphan drugs:

- Many medicines for rare diseases are **patented**, making them costly due to a small market and high development expenses, which discourages pharmaceutical companies from producing them.
- **To lower prices, India could develop these drugs**, but the government needs to offer **incentives like tax breaks**.
- While patients importing rare disease medicines are exempt from customs duties, companies face **11% customs duty and 12% GST.**

High Court ruling:

- The Delhi High Court has set a **30-day deadline** to process necessary exemptions under customs, GST, and Income Tax laws.
- In 2019, the **Department of Pharmaceuticals** removed **price controls on orphan drugs**, but the High Court expressed concerns, saying this can't go on.
    - If treatments or medicines for rare diseases are not available, the government can, under the **Patents Act of 1970**, allow a **third party to manufacture** them against payment of a royalty to the patent holder.
    - The government can also acquire patents to ensure the availability of medicines if the patent holder does not provide them.
- The court highlighted the **need for more research** on rare diseases and stressed that working with pharmaceutical companies and boosting local production could help lower treatment costs.

Unravelling Tuberculosis: How Mycobacterium tuberculosis Evades the Immune System

Sub :Sci

Sec :Health

Why in News

Researchers from **CSIR-Centre for Cellular and Molecular Biology (CCMB), Hyderabad** have made significant strides in understanding how **Mycobacterium tuberculosis (Mtb)**, the bacteria responsible for tuberculosis (TB), evades the immune response. A recent study published in the journal *eLife* highlights key enzymes that help Mtb survive in hostile environments, providing potential targets for new drugs.

Tuberculosis in India:

TB is a major **public health concern in India,** one of the highest TB burden countries globally. The Indian government has made TB elimination a key healthcare goal, with enhanced focus on diagnostics, patient management, and tracking.

What is Tuberculosis: Tuberculosis (TB) is an infectious **airborne bacterial disease** caused by **Mycobacterium tuberculosis.**

TB commonly affects the **lungs (pulmonary TB)** but can also affect **other parts (extrapulmonary TB)**

Tuberculosis **spreads** from person to person **through the air**, when people who are infected with TB infection cough, sneeze or otherwise transmit respiratory fluids through the air.

Genome Size: Mtb's genome consists of **4.4 million base pairs**, far larger than other respiratory bacteria like **Staphylococcus aureus (2.8 million)** and **Streptococcus pneumoniae (1.9-2.7 million)**. This extensive genome enables Mtb to produce a wide variety of proteins to evade immune defenses.

What is Multidrug-Resistant TB (MDR-TB):

- In MDR-TB, the bacteria that cause TB develop **resistance to antimicrobial drugs** used to cure the disease.

- MDR-TB **does not respond** to at least **isoniazid and rifampicin,** the 2 most powerful anti-TB drugs.
- Treatment options for MDR-TB are l**imited and expensive.**

About Antimicrobial Resistance (AMR):

- Increasing **antimicrobial resistance (AMR)** in Mtb is undermining the effectiveness of existing treatments. Researchers are urgently working to develop new antibiotics that can combat resistant strains.
- Antimicrobial Resistance (AMR) is the **ability of a microbe to resist the effects of medication** previously used to treat them. It is also known as **antibiotic resistance.**
- As a result, the **medicines become ineffective** and infections persist in the body.
- The WHO defines antimicrobial resistance as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism.
- The resistance to antimicrobials is a **natural biological phenomenon.** However, the **misuse and overuse** of antibiotics accelerates the development of AMR.
- Microbial resistance to antibiotics has made it harder to treat infections such as pneumonia, tuberculosis (TB), blood poisoning (septicaemia) and several food-borne diseases.

Coevolution of Mtb and Humans

The Mtb pathogen has coexisted with humans for millennia. Evidence suggests that the Mtb complex has been present for **over 70,000 years**, giving the bacteria ample time to adapt to human biology.

Macrophage Invasion: Mtb primarily infects **macrophages**, the **body's first line of defense against invading pathogens.** Macrophages usually destroy microbes through **oxidative stress**, but Mtb has evolved to survive and multiply inside them.

About Macrophage:

- Macrophages are a type of **white blood cell (phagocyte)** crucial for **the innate immune response.**
- **Phagocytosis**: They **engulf and digest foreign particles, bacteria, and dead or damaged cells** through phagocytosis.
- Found in nearly all tissues, they are especially **abundant in areas like the lungs, liver (Kupffer cells), brain (microglia), and spleen.**
- Derived from monocytes, a type of white blood cell, which transform into macrophages when they migrate from the blood into tissues.
- They **initiate oxidative stress reactions involving peroxides and free radicals to destroy pathogens,** including bacteria, viruses, and fungi.
- **Macrophages present antigens to T-cells,** helping trigger the adaptive immune response.
- **TB Survival Mechanism**: In tuberculosis, *Mycobacterium tuberculosis* can evade **macrophage defense, surviving and multiplying within the cells by forming protective clusters.**
- Macrophages can survive for **weeks to months in tissues,** continuing their protective and regulatory roles.

About Cysteine Synthase Enzymes:

- Researchers at CCMB identified that two enzymes, **CysK2** and **CysM**, are crucial for Mtb's survival during **nutrient deficiency** and **oxidative stress**. When these enzymes were disabled, Mtb's ability to produce antioxidants was impaired, reducing its survival.
- **Cysteine and Antioxidant Defense**: One group of proteins of particular interest is **cysteine synthase enzymes**. These enzymes are responsible for synthesizing **cysteine**, a sulfur-containing amino acid crucial for producing antioxidants. **Antioxidants disrupt oxidative stress, allowing Mtb to survive in macrophages.**
- Cysteine is essential for producing **antioxidants like glutathione,** which help **protect cells from oxidative stress.**
- In *Mycobacterium tuberculosis*, **cysteine synthases aid** in **surviving hostile environments** by countering oxidative damage.
- Common types include **CysK and CysM,** which are involved in different pathways for cysteine biosynthesis.
- These **enzymes are potential targets for antibiotics, as humans lack cysteine synthase,** making bacterial inhibitors promising for TB treatment.

NPPA revises the ceiling prices of eight scheduled drugs to meet the twin objectives of availability and affordability

Sub : Sci

Sec: Health

Context:

- The **National Pharmaceutical Pricing Authority (NPPA)** has approved a **50% increase** in the ceiling prices of **eleven essential formulations** from **eight different drugs.**

- **Drugs Affected**: These drugs are primarily **low-cost** and widely used as **first-line treatments** for conditions such as **asthma, glaucoma, thalassemia, tuberculosis**, and **mental health disorders.** They play a crucial role in public health programs.

Reason for the Price Hike:

- To ensure the availability of essential drugs at affordable prices.
- The **NPPA** emphasised that price regulation should not make these drugs unavailable in the market, which would jeopardise public health.
- **Factors Behind the Increase**:
  - Manufacturers have requested price revisions due to:
    - Rising costs of active pharmaceutical ingredients (APIs).
    - Increased production costs.
    - Changes in exchange rates.
  - Some companies have even applied to discontinue certain formulations, citing financial unviability.
- **Legal and Policy Context**:
  - The **NPPA** invoked extraordinary powers under **Paragraph 19** of the **Drugs (Prices Control) Order (DPCO), 2013,** to implement the **increase**.
- **Drugs with Revised Prices**:
  - Atropine injection (0.6 mg/ml).
  - Streptomycin powder for injection (750 mg and 1000 mg).
  - Salbutamol (tablet 2 mg and 4 mg; respirator solution 5 mg/ml).
  - Pilocarpine (2% eye drops).
  - Cefadroxil (tablet 500 mg).
  - Desferrioxamine (injection 500 mg).
  - Lithium (tablet 300 mg).
- **Previous Price Revisions**:
  - Similar price increases occurred in **2019** and **2021,** where **NPPA** raised the prices of **21** and **9** formulations, respectively, to maintain the availability of these essential medicines.

About National Pharmaceutical Pricing Authority (NPPA):

- **Establishment:** NPPA was established in 1997 as an independent body under the Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India.
- **Primary function:** Its main role is to fix/revise the prices of controlled bulk drugs and formulations and to enforce prices and availability of medicines in India.
- **Key responsibilities:**
  - Implement and enforce the provisions of the Drugs (Prices Control) Order
  - Monitor the availability of drugs
  - Identify shortages and take remedial steps
  - Collect and maintain data on production, exports, imports, and market share of pharmaceutical companies
- **Price control:** NPPA fixes the ceiling price of essential medicines as per the National List of Essential Medicines (NLEM).
- **Drug Price Control Order (DPCO):** NPPA implements the DPCO, which is an order issued by the government to regulate drug prices in India.
- Consumer protection: It works to ensure that essential medicines are available at reasonable prices to consumers.
- **Authority:** NPPA has the power to review prices of non-scheduled drugs and can take appropriate action if any medicine is deemed to be priced unreasonably.
- **Challenges:** The authority often faces challenges in balancing the interests of pharmaceutical companies with those of consumers, and in ensuring drug availability while maintaining price controls.

Regulation of Antibiotics: A Step Toward Combating Antimicrobial Resistance in India
Sub : Sci
Sec: Health
Why in News

The **Drugs Technical Advisory Board (DTAB)** has proposed the regulation of antibiotic manufacturing and marketing by including all antibiotics under the **definition of "new drugs"** in the **New Drugs and Clinical Trial (NDCT) Rules, 2019**. This recommendation aims to address the growing threat of **antimicrobial resistance (AMR)**, which has emerged as a critical global health concern.

Regulation of Antibiotics in India

- The DTAB has recommended that all antibiotics be classified as **new drugs** under the **NDCT Rules, 2019**. This move is part of a broader effort to regulate the use and sale of antibiotics to combat **antimicrobial resistance**.
- **Definition of "New Drug"**: If accepted, antibiotics will fall under the **new drug category,** meaning their **manufacturing, marketing, and sale** will require **additional regulatory scrutiny.**
- The over-prescription and misuse of antibiotics, **antivirals**, and **antifungals** contribute to the rise of antimicrobial resistance. The inclusion of antibiotics in the "new drug" category is seen as a critical measure to prevent misuse.

Curbing Antimicrobial Resistance (AMR)

- **Global Health Threat**: **Antimicrobial resistance (AMR)** is increasingly recognized as a major public health threat worldwide. Misuse and overuse of antibiotics have contributed significantly to this issue.
- Infections such as **urinary tract infections (UTIs), bloodstream infections, pneumonia, and typhoid** have become resistant to commonly used antibiotics in India, posing serious health risks.

About Antimicrobial Resistance (AMR):

- Antimicrobial Resistance (AMR) is the **ability of a microbe to resist the effects of medication** previously used to treat them. It is also known as **antibiotic resistance.**
- As a result, the **medicines become ineffective** and infections persist in the body.
- **The WHO defines antimicrobial resistance as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism.**
- The resistance to antimicrobials is a **natural biological phenomenon.** However, the **misuse and overuse** of antibiotics accelerates the development of AMR.
- Microbial resistance to antibiotics has made it harder to treat infections such as pneumonia, tuberculosis (TB), blood poisoning (septicaemia) and several food-borne diseases.

Regulatory Implications

- With the new classification, the **manufacturing and marketing** of antibiotics will require clearance from the **Union government**, rather than state drug authorities.
- Antibiotics will **only be available** with a valid **prescription**, limiting over-the-counter sales and reducing misuse.
- There are also discussions to **amend labelling requirements** under the **Drugs Rules, 1945**, including the addition of a **blue strip or box** to identify antimicrobial products.

Fortified Rice in India: A Safe Solution for Combating Micronutrient Deficiencies

Sub: Sci

Sec: Health

Why in News

The safety of **fortified rice** has been under scrutiny due to concerns about its effects on individuals with blood disorders like **Thalassemia and Sickle Cell Anaemia.** The Centre, however, maintains that fortified rice is safe for all, as it follows **WHO guidelines** and is part of a national initiative to address **micronutrient deficiencies.**

Rice fortification:

Rice fortification is the process of **adding essential vitamins and minerals** to rice to improve its nutritional content and address micronutrient deficiencies. Fortified rice typically contains added **iron, folic acid, vitamin B12, and sometimes zinc and vitamin A.**

Process of Rice Fortification: Rice kernels are fortified with micronutrients through methods like **dusting, coating, or extrusion**, where nutrients are added to rice during processing. These **fortified kernels** are then blended with normal rice in a specific ratio, usually around **1:100**, ensuring that the final product contains adequate levels of the added nutrients.

The **Food Safety and Standards Authority of India (FSSAI)** defines fortification as **"deliberately increasing the content of essential micronutrients in a food so as to improve the nutritional quality of food and to provide public health benefit with minimal risk to health".**

The cooking of fortified rice **does not require any special procedure.**

After cooking, **fortified rice retains the same physical properties and micronutrient levels as it had before cooking.**

Fortified rice will be packed in jute bags with the logo ('+F') and the line "Fortified with Iron, Folic Acid, and Vitamin B12".

Various technologies are available to add micronutrients to regular rice, such as **coating, dusting, and 'extrusion'**.

The Extrusion technique involves the **production of fortified rice kernels (FRKs) from a mixture using an 'extruder' machine.**

Need of rice fortification:

India has very **high levels of malnutrition** among women and children.

According to the Food Ministry, **every second woman in the country is anaemic** and **every third child is stunted.**

Fortification of food is considered to be one of the **most suitable methods to combat malnutrition.**

What are the standards for fortification?

Under the Ministry's guidelines, **10 g of FRK must be blended with 1 kg of regular rice.**

According to FSSAI norms, **1 kg of fortified rice will contain the following: iron (28 mg-42.5 mg), folic acid (75-125 microgram), and vitamin B-12 (0.75-1.25 microgram)**.

Rice may also be fortified with **zinc (10 mg-15 mg), vitamin A (500-750 microgram RE), vitamin B-1 (1 mg-1.5 mg), vitamin B-2 (1.25 mg-1.75 mg), vitamin B-3 (12.5 mg-20 mg) and vitamin B-6 (1.5 mg-2.5 mg) per kg.**

Advantages

Fortified staple foods will contain **natural or near-natural levels of micro-nutrients,** which may not necessarily be the case with supplements.

It **provides nutrition without any change in the characteristics of food** or the course of our meals.

If consumed on a regular and frequent basis, **fortified foods will maintain body stores of nutrients more efficiently and more effectively** than will intermittently supplement.

The **overall costs of fortification are extremely low;** the price increase is approximately 1 to 2 percent of the total food value.

It **upholds everyone's right to have access to safe and nutritious food,** consistent with the right to adequate food and the fundamental right of everyone to be free from hunger

Issues with fortified food

Fortification and enrichment upset nature's packaging. Our body does not absorb individual nutrients added to processed foods as efficiently compared to nutrients naturally occurring,

Supplements added to foods are less bioavailable. Bioavailability refers to the proportion of a nutrient your body is able to absorb and use.

They lack immune-boosting substances.

Fortified foods and supplements **can pose specific risks for people who are taking prescription medications,** including decreased absorption of other micro-nutrients, treatment failure, and increased mortality risk.

Importance in India:

India launched rice fortification as part of a national effort to improve nutrition, particularly through schemes like the **Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY)**, aiming to reduce **malnutrition** and **micronutrient deficiencies**.

Safety for Individuals with Hemoglobinopathies

Thalassemia and Sickle Cell Anaemia: The Centre affirmed that fortified rice is safe for individuals suffering from these conditions.

The **iron intake from fortified rice** is minimal when compared to iron absorbed through regular **blood transfusions** in Thalassemia patients.

People with **Sickle Cell Anaemia** naturally regulate iron absorption due to elevated levels of **hepcidin**, a hormone controlling iron uptake.

About Sickle cell disease:

Sickle cell disease is an inherited blood disorder. It is marked by flawed haemoglobin. That's the protein in red blood cells that carries oxygen to the tissues of the body. So, sickle cell disease interferes with the delivery of oxygen to the tissues.

Red blood cells with normal haemoglobin are **smooth, disk-shaped, and flexible, like doughnuts without holes.** They can move through the blood vessels easily. Cells with sickle cell haemoglobin are stiff and sticky.

When they lose their oxygen, **they form into the shape of a sickle or crescent, like the letter C.** These cells stick together and can't easily move through the blood vessels. This can block small blood vessels and the movement of healthy, normal oxygen-carrying blood. The blockage can cause pain.

Normal red blood cells can live up to 120 days. But **sickle cells only live for about 10 to 20 days.** Also, sickle cells may be destroyed by the spleen because of their shape and stiffness. The spleen helps filter the blood of infections.

Sickled cells get stuck in this filter and die. With less healthy red blood cells circulating in the body, you can become chronically anaemic. The sickled cells also damage the spleen. This puts you are at greater at risk for infections.

About Thalassemia:

Thalassemia is an **inherited blood disorder wherein the body produces an inadequate amount of haemoglobin.** Haemoglobin is a protein molecule that carries oxygen in the red blood cells. This disorder results in the **extreme destruction of red blood cells that leads to anaemia.**

Anaemia is a condition in which the haemoglobin or red blood cells are less than the normal count.

Mild thalassemia requires no treatment, but acute thalassemia might require regular blood transfusions.

NPPA revises the ceiling prices of eight scheduled drugs to meet the twin objectives of availability and affordability

Sub : Sci

Sec: Health

Context:

- The **National Pharmaceutical Pricing Authority (NPPA)** has approved a **50% increase** in the ceiling prices of **eleven essential formulations** from **eight different drugs.**
- **Drugs Affected**: These drugs are primarily **low-cost** and widely used as **first-line treatments** for conditions such as **asthma, glaucoma, thalassemia, tuberculosis**, and **mental health disorders.** They play a crucial role in public health programs.

Reason for the Price Hike:

- To ensure the availability of essential drugs at affordable prices.
- The **NPPA** emphasised that price regulation should not make these drugs unavailable in the market, which would jeopardise public health.
- **Factors Behind the Increase**:
    - Manufacturers have requested price revisions due to:
        - Rising costs of active pharmaceutical ingredients (APIs).
        - Increased production costs.
        - Changes in exchange rates.
    - Some companies have even applied to discontinue certain formulations, citing financial unviability.
- **Legal and Policy Context**:
    - The **NPPA** invoked extraordinary powers under **Paragraph 19** of the **Drugs (Prices Control) Order (DPCO), 2013,** to implement the **increase**.
- **Drugs with Revised Prices**:
    - Atropine injection (0.6 mg/ml).
    - Streptomycin powder for injection (750 mg and 1000 mg).
    - Salbutamol (tablet 2 mg and 4 mg; respirator solution 5 mg/ml).
    - Pilocarpine (2% eye drops).
    - Cefadroxil (tablet 500 mg).
    - Desferrioxamine (injection 500 mg).
    - Lithium (tablet 300 mg).
- **Previous Price Revisions**:
    - Similar price increases occurred in **2019** and **2021,** where **NPPA** raised the prices of **21** and **9** formulations, respectively, to maintain the availability of these essential medicines.

About National Pharmaceutical Pricing Authority (NPPA):

- **Establishment:** NPPA was established in 1997 as an independent body under the Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India.
- **Primary function:** Its main role is to fix/revise the prices of controlled bulk drugs and formulations and to enforce prices and availability of medicines in India.
- **Key responsibilities:**
    - Implement and enforce the provisions of the Drugs (Prices Control) Order
    - Monitor the availability of drugs
    - Identify shortages and take remedial steps
    - Collect and maintain data on production, exports, imports, and market share of pharmaceutical companies
- **Price control:** NPPA fixes the ceiling price of essential medicines as per the National List of Essential Medicines (NLEM).

- **Drug Price Control Order (DPCO):** NPPA implements the DPCO, which is an order issued by the government to regulate drug prices in India.
- Consumer protection: It works to ensure that essential medicines are available at reasonable prices to consumers.
- **Authority:** NPPA has the power to review prices of non-scheduled drugs and can take appropriate action if any medicine is deemed to be priced unreasonably.
- **Challenges:** The authority often faces challenges in balancing the interests of pharmaceutical companies with those of consumers, and in ensuring drug availability while maintaining price controls.

India's Push for WHO Certification in Eliminating Kala-azar

Sub :Sci

SEC: Health

Why in News

India is on the verge of achieving a significant milestone by seeking certification from the **World Health Organization (WHO)** for **eliminating Kala-azar** as a public health problem. The country has maintained the required criteria for elimination—less than one case per 10,000 people for two consecutive years.

About Kala Azar:

Kala-azar, also known as visceral leishmaniasis, is the second deadliest parasitic disease after malaria in India.

The disease is caused by the **protozoan parasite *Leishmania donovani*,** transmitted through the bite of an infected **female sandfly.**

Kala Azar is a parasitic infection transmitted by sandflies. It causes fever, weight loss, spleen and liver enlargement.

It is characterized by irregular bouts of fever, weight loss, enlargement of the spleen and liver, and anemia.

Most cases occur in Brazil, east Africa and India.

Kala-azar is a treatable and curable disease, which requires an immunocompetent system.

If left untreated, it can be fatal in 95% of cases.

PKDL or Post Kala-azar dermal leishmaniasis, is a well-recognised complication which causes scaly skin patches and nodular lesions in people who have been apparently cured of Kala Azar up to two years of the initial infection.

Leishmania-HIV co-infection refers to the People living with HIV and who are infected with leishmaniasis have high chances of developing the full-blown disease, high relapse and mortality rates.

Patients only need an IV drip of the medicine, which takes about two hours, for the infection to be cured.

There are 3 main forms of the disease:

Visceral leishmaniasis (VL), also known as kala-azar, is fatal if left untreated in over 95% of cases. It is characterized by irregular bouts of fever, weight loss, enlargement of the spleen and liver, and anemia.

Most cases occur in **Brazil, east Africa and India.**

Cutaneous leishmaniasis (CL) is the most common form and causes **skin lesions, mainly ulcers, on exposed parts of the body.** These can leave life-long scars and cause serious disability or stigma.

Mucocutaneous leishmaniasis leads to **partial or total destruction of mucous membranes of the nose, mouth and throat.**

India's Progress Towards Elimination:

To achieve WHO certification, India must maintain a rate of fewer than **one case per 10,000 people** for another year. This would make India the second country, after **Bangladesh**, to eliminate Kala-azar as a public health issue.

India's **National Health Policy (2002)** originally aimed to eliminate Kala-azar by **2010**, but this goal has been revised multiple times to **2015, 2017**, and finally **2020**.

The WHO set a global target to eliminate Kala-azar by **2020**, which has now been extended to **2030** due to delays.

WHO Certification Criteria: A disease is declared eliminated when a country can prove that **local transmission has been interrupted** for a specific time period and there are preventive measures in place to avoid a resurgence. India's elimination certification depends on maintaining less than one case per 10,000 people at the **sub-district (block PHCs)** level for two consecutive years.

Vulnerable Regions:

The highest number of Kala-azar cases come from **Bihar, Jharkhand, West Bengal**, and parts of **Uttar Pradesh**.

Bihar alone accounts for **70%** of the country's cases, driven by factors like **poor sanitation** and **climate conditions**, which are conducive to sandfly breeding.

Egypt becomes 2nd country in 2024 to be declared 'malaria-free'

Sub: Sci

<u>**Sec: Human health**</u>

Egypt Declared Malaria-Free by WHO

- On October 20, 2024, **Egypt** was officially declared **malaria-free** by the **World Health Organization (WHO)**, becoming the **second country in 2024** after **Cabo Verde** and the **fifth African nation** to receive this certification.
- **Egypt's malaria-free status** is the result of **nearly a century of continuous efforts** to eradicate the disease.

Historical Efforts Against Malaria:

- **4000 BCE**: Malaria was present in Egypt, especially in **Nile River communities**.
- **1920s**: Egypt began reducing **human-mosquito contact**, banning **rice cultivation** near homes.
- **1930s**: Malaria became a **notifiable disease**, and control stations were established.
- **World War II**: **Malaria cases** surged to over **3 million** due to factors like population displacement and medical supply disruptions.
- **1950s-1960s**: Environmental management, mosquito surveillance, and **DDT** campaigns reduced malaria significantly.
- **Aswan Dam (1969)**: New risks arose due to **stagnant water,** but joint efforts with **Sudan** controlled the threat.
- **2014**: A brief outbreak in **Aswan** was swiftly contained, and **no malaria case** was diagnosed for two years after that.

Key Factors Behind Egypt's Malaria-Free Status:

- **Egypt's surveillance system,** in collaboration with various stakeholders, allowed early detection of imported cases.
- **95% of Egypt's population** now lives within **5 kilometres** of a primary health centre, with **free diagnosis and treatment** for all, including undocumented migrants.
- **Integrated Efforts**: The **High Committee for Integrated Vector Management** was formed in **2016** to enhance coordination in **fighting vector-borne diseases.**
- **Cross-border Cooperation**: Egypt continues close partnerships with endemic countries like Sudan to prevent the re-establishment of malaria.
- Egypt's success is seen as a **model** for other countries, particularly those in **Africa**, like **Nigeria**, which carries the **highest global malaria burden.**

Certification and Global Impact:

- To achieve WHO's **malaria-free** certification, a country must prove that **no local malaria transmission** has occurred for **three consecutive years** and that systems are in place to prevent its return.
- With this announcement, **44 countries** and **one territory worldwide** have now been **certified malaria-free.**

Malaria:

- **Malaria** is a **life-threatening disease** caused by **Plasmodium parasites**, transmitted to humans through the **bites** of **infected female Anopheles mosquitoes.**
- **Five species of Plasmodium** can cause malaria in humans:
1. falciparum (most severe form)
2. vivax
3. ovale
4. malariae
5. knowlesi

Transmission:

- **Primary vector:** Female Anopheles mosquitoes
- Mosquitoes bite between dusk and dawn
- Can also be transmitted through: Blood transfusions, Organ transplants, Shared needles, From mother to unborn child

Symptoms

- **Early Symptoms** (typically appear 10-15 days after infection): Fever, Chills, Headache, Muscle aches, Fatigue, Sweating, Nausea and vomiting
- **Severe Malaria Symptoms:** Severe anemia, Respiratory distress, Cerebral malaria, Organ failure, Abnormal blood coagulation

Diagnosis:

- Blood tests (microscopy), Rapid diagnostic tests (RDTs), PCR testing for species identification, Antibody tests

Treatment

- **Medications**
  - o Artemisinin-based combination therapy (ACT)

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- o Chloroquine (where parasites remain susceptible)
- o Primaquine (for P. vivax and P. ovale)
- o Atovaquone-proguanil
- **Vaccines:**
  - o RTS,S/AS01 (Mosquirix) - first approved malaria vaccine
  - o R21/Matrix-M vaccine showing promising results
  - o Ongoing research for more effective vaccines

Prevention:
- **Personal Protection**
  - o Insecticide-treated bed nets, Protective clothing, Insect repellent, Window screens, Air conditioning
- **Chemoprophylaxis (Preventive Medications)**
  - o Atovaquone-proguanil, Doxycycline, Mefloquine, Chloroquine (in limited areas)
- **Community Prevention**
  - o Indoor residual spraying, Environmental management, Mosquito breeding site elimination, Community Education

Global Impact:
- Approximately 241 million cases annually
- Over **600,000 deaths per year**
- Most deaths occur in **sub-Saharan Africa**
- Children under 5 most vulnerable

FDA Approval of Cobenfy: A New Milestone in Schizophrenia Treatment

Sub: Sci

Sec: Health

Why in News

The **U.S. Food and Drug Administration (FDA)** recently approved **Cobenfy**, a novel **antipsychotic drug** designed to treat **schizophrenia** by **targeting cholinergic receptors,** making it the **first of its kind.** This breakthrough comes at a time when addressing the limitations of traditional schizophrenia treatments remains a priority in medical research.

About Schizophrenia:

Schizophrenia is a **severe psychiatric disorder** that affects approximately **1 in 100 people** globally. It has debilitating effects on a **person's social, mental, and physical well-being.**

The disorder typically **manifests in late adolescence or early adulthood,** with men often affected in their early 20s and women experiencing a second peak in their 40s.

Symptoms of schizophrenia fall into three categories: **positive symptoms (hallucinations, delusions), negative symptoms (apathy, lack of motivation), and cognitive symptoms (impaired memory and judgment).**

Schizophrenia is a **polygenic disorder**, meaning it is influenced by hundreds or even thousands of small-effect genes. A **2014 genome-wide study** identified **108 genetic loci** linked to schizophrenia.

Traditional treatments have primarily focused on **dopamine receptor antagonism**, which led to the development of drugs like **antipsychotics**. However, these drugs often come with severe **side effects**, including weight gain, metabolic issues, and cognitive dulling.

About Cobenfy:

Cobenfy, approved by the FDA, combines two compounds, **xanomeline** and **trospium chloride**. Unlike traditional drugs that target dopamine, **Cobenfy targets cholinergic receptors**.

Xanomeline activates **muscarinic receptors,** which may address all types of **schizophrenia symptoms,** while **trospium chloride** minimizes adverse effects.

Cobenfy marks a significant shift in the treatment of schizophrenia. By **avoiding dopamine receptor modulation,** it offers a new hope for patients who are resistant to or unable to tolerate dopamine-based treatments.

Can a popular weight-loss drug reduce risk of Alzheimer's?

Sub : Sci

Sec :Human health

Context:

- Recent research indicates that **semaglutide**, an **active ingredient in diabetes and weight loss drugs** such as Ozempic and Wegovy, may significantly **reduce the risk of developing Alzheimer's disease (AD)** in individuals with **type 2 diabetes**.
- This finding has been published in the journal *Alzheimer's & Dementia*.

Study Methodology:
- Researchers examined health records of over one million US patients with type 2 diabetes.
- The study compared the effects of **semaglutide against seven other diabetes medications**, including **metformin, insulin and liraglutide**, tracking patients for up to **three years** for AD diagnoses.

Key findings of the study:
- Semaglutide was found to lower the risk of a first-time Alzheimer's diagnosis by **40% to 70%** compared to other diabetes medications.
- The study results were **consistent across various demographics**, including age, gender, and obesity status.
- The benefits of semaglutide became apparent within 30 days of treatment, with sustained effects observed over time.

How it works:
- The study on GLP-1 receptor agonists (GLP-1 RAs), including semaglutide, suggests they may protect brain function and mitigate Alzheimer's disease (AD) progression.
- The findings indicate that semaglutide can **lower toxic protein levels, improve glucose utilization in brain cells, reduce harmful plaques and tangles, and decrease neuroinflammation**, all of which are linked to AD.

Potential implications:
- The US Food and Drug Administration (FDA) has approved two treatments, **Biogen's Leqembi and Eli Lilly's Kisunla**, that marginally slow the progression of AD by targeting the disease's hallmark amyloid plaques in the brain. But these can cause serious **side effects, including brain swelling and brain bleeding**.
- GLP-1 drugs present a dual-purpose approach by managing diabetes and potentially preventing dementia, without the side effects.
- This is particularly important for India, which has high rates of type 2 diabetes associated with **cognitive decline** due to insulin resistance, inflammation, and oxidative stress.

About Alzheimer's disease:
- A progressive disease wherein, brain cell connections and the cells themselves degenerate and die, eventually destroying memory and other important mental functions.
- Alzheimer's causes a **gradual decline in memory, thinking, behaviour, and social skills**, and it is the **most common cause of dementia**.
- **No cure exists**, but medication and management strategies may temporarily improve symptoms.

Strengthening Animal Health Security: India's $25-Million Pandemic Fund to Tackle Zoonotic Diseases

Sub : Sci

Sec :Human health

Why in News

The **Government of India,** in collaboration with international organizations like the **Asian Development Bank (ADB), World Bank, and the Food and Agriculture Organization (FAO),** has launched a **$25-million G-20 pandemic fund project.** The project is focused on **strengthening animal health security,** enhancing **zoonotic disease monitoring,** and building a resilient framework for **pandemic preparedness.**

$25 Million G20 Pandemic Fund Project:

Established under **Indonesia's G20 Presidency in 2022,** the initiative specifically targets improving the capacity of **low- and middle-income countries** to respond to animal disease outbreaks that pose pandemic risks.

Implementing Entities: **Asian Development Bank (ADB), World Bank, and Food and Agriculture Organization (FAO).**

Primary Goal: Enhance countries' capabilities to **prevent, detect, and respond to zoonotic diseases,** reducing the risk of pandemics.

Significance: Five of the six public health emergencies declared by the **World Health Organization (WHO)** were of **animal origin.** Previous outbreaks like **SARS and Avian Flu** have caused substantial global economic losses, estimated at $50 billion and $30 billion, respectively, highlighting the **need for robust animal health systems to mitigate such impacts.**

Global Health Security Index: India scored **42.8** on the Global Health Security Index, indicating **high environmental risks and public health vulnerabilities.**

Key Components of the Project:

Upgrading and expanding animal health labs across the country to facilitate **early detection and diagnosis** of **zoonotic diseases.**

Introducing **genomic and environmental surveillance to detect zoonotic diseases** early, preventing their spread to humans.

Strengthening partnerships with neighbouring countries to improve the **monitoring and management** of zoonotic diseases, recognizing the **transnational nature of these pathogens.**

Upgrading **data management systems** and enhancing **analytics capabilities** to facilitate **better risk assessment** and **decision-making.**

Developing a **disaster management framework** specifically for the **livestock sector,** aiding in effective response to **zoonotic outbreaks.**

<u>**What are Zoonotic Diseases?**</u>

Zoonosis refers to the **transmission of diseases between animals and humans.** Such diseases are termed **Zoonotic Diseases.**

Zoonotic diseases range from **mild to severe, while in extreme cases can even be fatal.**

Zoonoses may be **bacterial, viral, or parasitic,** or may even **involve unconventional agents for the transmission** of the disease.

WHO in 1959 defined Zoonoses as "those diseases and infections which are naturally transmitted between vertebrate animals and man."

World Zoonoses Day is observed every year on July 6 to create awareness on zoonotic diseases, how to prevent them, and what actions to take when exposed.

COVID -19 is an example of a zoonotic disease which broke out in China's Wuhan district in December 2019.

Impact of Climate Change: Climate change has **intensified the risks and occurrences of zoonotic diseases** in India. Diseases carried by mosquito species like *Aedes aegypti* **and** *Aedes albopictus* are becoming more prevalent, raising health concerns.

Implications of H5N1 Virus in Cattle and Humans: An Emerging Threat

Sub : Sci

Sec : Human health

Why in News

The emergence of a **new clade of Avian Influenza H5N1** in cattle and its potential implications for human health have garnered attention. The rapid spread of this **highly contagious virus** has raised concerns regarding its impact on **agriculture, public health, and zoonotic disease transmission.**

<u>**What is the H5N1 virus?**</u>

Influenza A virus subtype H5N1 (A/H5N1) is a subtype of the **influenza A virus,** which causes influenza (flu), predominantly in birds.

It is **enzootic (maintained in the population) in many bird populations, and also panzootic (affecting animals of many species over a wide area).**

A/H5N1 virus can also infect mammals (including humans) that have been exposed to infected birds; in these cases, symptoms are frequently severe or fatal.

Ever since it emerged in **1996,** H5N1 has resulted in the **mass killing of billions of wild birds as well as fowls.**

According to scientists, the **virus lacks changes** that would make it better adapted to transmit between people and therefore, the risk to human health remains low.

The potential for influenza viruses to rapidly evolve and the **wide geographic spread of H5N1 signals that more human infections should be expected.**

New Clade Emergence: The **Avian Influenza H5N1 (clade 2.3.4.4b) emerged in late 2020,** leading to a global outbreak primarily spread by migratory birds.

Millions of birds have died due to the outbreak, and the virus has been detected in over 200 mammalian species, including humans.

Human Cases: As of **April 2024,** human infections from the outbreak in cattle were noted, with 26 cases reported across multiple states, including Texas and California. Most cases involved individuals with direct contact with infected cattle or poultry.

Why is WHO cagey about publishing Meghalaya polio case details

Sub : Sci

Sec: Human Health

Context:

- The **Meghalaya polio case** involving a **two-year-old boy** has raised concerns about **information transparency from health authorities,** including the **WHO.**

Key Details of the Meghalaya Polio Case:

- **Initial Detection**: The boy from **West Garo Hills** district in **Meghalaya** displayed **polio symptoms** in early August.
- On August 12, the **ICMR-NIV Mumbai lab** confirmed it as a **type-1 vaccine-derived poliovirus (VDPV)**. The results were shared with **India's Health Ministry,** the **Meghalaya government**, and the **WHO**.
- **CDC Confirmation**: The **CDC Atlanta** also confirmed the **type 1 VDPV.**
- **Immunological Profile**: Follow-up tests by **ICMR-NIV** revealed the **child's immune profile** was normal, ruling out an **immunodeficiency-related VDPV (iVDPV).**
- **Cause**: The **polio** resulted from a **mutation** in the **weakened type-1 virus strain** used in the **oral polio vaccine.** The child, who was not **fully immunized, contracted polio,** but there was **no evidence** of the virus circulating in the community.

Delay in Public Announcement by WHO and GPEI:
- Despite having details of the case by August 12, neither the **WHO** nor the **Global Polio Eradication Initiative (GPEI)** has published an official statement.

Like the Health Ministry and the Meghalaya State government, WHO too has not made any official announcement of the case till date

- On August 12, the ICMR-NIV Mumbai unit had shared the results of the Meghalaya polio case with the Health Ministry, the Meghalaya State government, and the WHO
- Before mid-September, the follow-up test results of the child's immunological profile and virus circulation in the community were shared with the WHO, the Health Ministry and the State government

- On September 16, WHO told The Hindu that the case was a type-1 VDPV. WHO also said that the child was not immunocompromised and there was no evidence of virus circulation in the community

- Despite having all the details of the case, WHO has not published the
- The Global Polio Eradication Initiative (GPEI) too has remained silent about the
- On May 26, 2017, WHO posted the details about the three Zika virus cases in Gujarat between November 2016 and January 2017 just
- Zika virus was no longer in circulation in Gujarat when WHO published the news. Also, like in the Meghalaya polio case, the Health

Comparisons with Previous Cases:
- **Global Response Time**:
    - **Israel (2022)**: GPEI announced a **type-3 circulating vaccine-derived poliovirus (cVDPV3)** case 10 days after it was detected in an unvaccinated child.
    - **U.S. (2022)**: A **type-2 VDPV case** in **New York** was announced by **GPEI** within three days after **CDC** was notified.
- **WHO Response Time**:
    - **WHO's Disease Outbreak** News took 45 and 38 days to report the cases in Israel and the U.S., respectively, in 2022.
    - **Zika Case in Gujarat (2017)**: WHO reported three Zika virus cases in Gujarat 11 days after being informed, despite limited circulation of the virus at the time.

Concerns Raised
- **Lack of Transparency**: The delay by **WHO** and **GPEI** contrasts with their faster response in similar cases worldwide.
- **Public Health Communication**: Questions arise about WHO's adherence to its stated commitment to quickly disseminate information on acute public health events per the International Health Regulations (2005).

Polio Virus:
- Poliovirus is highly infectious, primarily affecting **children under 5.**
- Transmitted through **contaminated water/food** (fecal-oral route)
- Most infections (72%) are **asymptomatic**
- Can cause **paralysis** in about **1/200 infections** by attacking the **nervous system**
- **Three serotypes: Type 1, 2,** and **3** (Type 2 and 3 have been eradicated globally)

Polio Vaccines:
1. **Inactivated Polio Vaccine (IPV):**
- Injectable vaccine containing killed virus
- Provides excellent immunity
- **Cannot cause vaccine-derived polio**
- More expensive

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- Requires trained healthcare workers

2. **Oral Polio Vaccine (OPV):**

- Contains weakened live virus
- Given as oral drops
- Less expensive
- Easier to administer
- Provides intestinal immunity
- Can be transmitted to others, helping community protection

Vaccine-Derived Poliovirus (VDPV):

- **Rare cases** where the **weakened virus in OPV mutates and regains virulence**
- Occurs in **under-immunized populations**
- **Takes 12-18 months of circulation** to become virulent
- **Three types:**
1. **Circulating VDPV (cVDPV):** Community transmission
2. **Immunodeficiency VDPV (iVDPV):** In immunocompromised individuals
3. **Ambiguous VDPV (aVDPV):** Source unclear

Prevention of VDPV:

1. High vaccination coverage (>80%)
2. Switching to IPV in areas with good coverage
3. Environmental surveillance
4. Rapid response to outbreaks

Global Strategy:

- WHO recommends using both **IPV** and **OPV**
- Gradual transition from **OPV** to **IPV** globally
- Special focus on remaining endemic countries
- Enhanced surveillance for **VDPV cases**

The Need for Regulatory Frameworks for Medicinal Foods in India

Sub :Sci

Sec: Health

Why in News

The growing health and wellness industry in India and globally has spotlighted the need for robust regulations around medicinal foods. Recently, a study conducted by researchers from **The University of Trans-Disciplinary Health Sciences and Technology (TDU), Bengaluru, and the Royal Botanic Gardens in the U.K.,** funded by the **British High Commission,** investigated the overlap between food and medicinal plant use. The study underscores the importance of establishing clear regulatory standards for medicinal foods to ensure safety, efficacy, and accessibility.

Medicinal Foods: A Missing Category in Regulatory Frameworks

Researchers are increasingly exploring **plant-based compounds for therapeutic uses,** as seen with **turmeric's** active component, **curcumin,** which has shown potential in **treating inflammation and certain cancers.**

Traditional uses of these plants often involve much lower dosages than those administered in **clinical trials, raising questions about their safety and efficacy** when used in larger, therapeutic doses.

Demand for Nutraceuticals: Nutraceuticals are food ingredients with **health benefits beyond basic nutrition,** offering potential medicinal benefits.

About Nutraceuticals

It is a broad umbrella term that is used to describe **any product derived from food sources with extra health benefits in addition to the basic nutritional value** found in foods.

They can be considered **non-specific biological therapies used to promote general well-being**, control symptoms and prevent malignant processes.

The term "nutraceutical" combines two words – "nutrient" (a nourishing food component) and "pharmaceutical" (a medical drug).

They can be classified on the basis of their natural sources, pharmacological conditions, as well as chemical constitution of the products. Most often they are grouped in the following categories: **dietary supplements, functional food, medicinal food, pharmaceuticals**.

Regulatory Gaps in Medicinal Food Safety:

Inconsistent Regulations for Food and Drugs: In many countries, including India, food and medicines are regulated by separate bodies: the **Food Safety and Standards Authority of India (FSSAI) oversees food, while the Central Drugs Standard Control Organisation (CDSCO) regulates drugs.** There is currently **no unified framework to handle substances that are both food and medicine,** posing potential risks for consumers due to varying regulatory standards for safety and efficacy.

Need for a Dedicated Medicinal Food Category: Given the **dual nature of many plants, establishing a new regulatory category for medicinal foods would provide much-needed clarity.** The U.K.'s Medicines and Healthcare Products Regulatory Agency, for example, recognizes **"border products"** that lie **between food and medicines,** which could serve as a model for India.

Important Medicinal Plants:

Giloy (Tinospora cordifolia): In Ayurveda**, giloy is traditionally used for its stem,** but modern applications sometimes incorporate other parts like leaves and roots, potentially altering its medicinal impact.

Ashwagandha (Withania somnifera): Only the **root is generally used for medicinal purposes,** but comprehensive labelling of consumer products is often missing.

Bhringaraj as Medicine and Food: Known for promoting hair health, **bhringaraj (Eclipta prostrata) is also consumed as a vegetable in some regions,** yet **IFCT 2017** does not provide nutritional information for it. This illustrates the need for clearer documentation of medicinal foods within regulatory frameworks.

Way Forward for Regulatory Bodies

India and other nations would benefit from a **regulatory framework** specifically for medicinal foods, ideally with a **central authority overseeing both the food and medicinal uses of plants.**

A **standardized plant nomenclature system** would prevent discrepancies across scientific, commercial, and regulatory domains.

Establishing a coherent regulatory system will protect consumers from potential risks associated with medicinal foods, **bolster industry credibility,** and promote the use of traditional knowledge.

As the health and wellness industry expands, **an efficient regulatory framework will ensure safe and accessible plant-based health products for consumers.**

Centre releases standard veterinary treatment guidelines for livestock and poultry

Sub :Sci

Sec: Health

Context:

- The **Department of Animal Husbandry and Dairying (DAHD)**, Government of India, launched the **Standard Veterinary Treatment Guidelines (SVTGs)** for livestock and poultry.

- Developed in collaboration with the **Food and Agriculture Organization (FAO)** and supported by **USAID**, these guidelines aim to standardize veterinary treatment across India, ensuring improved animal health and responsible drug use.

Key Details of SVTGs:

- **Purpose**: To guide veterinarians, animal health professionals, and paraprofessionals in delivering standardized, rational treatment for various animal diseases.

- Available as a compact digital manual for easy access on mobile devices.

- A "Live" document updated every 2-3 years based on field feedback and advancements in veterinary practices.

Content Structure:

- **Animal Types Covered**: Guidelines cover diseases in **cattle, buffaloes, goats, sheep, poultry, pigs, camels, equines, mithuns,** and **yaks.**

- **Disease Categories**: Includes infectious, non-infectious, and parasitic diseases, with specific chapters on each.
  - **Details Provided**: Etiology, clinical signs, diagnosis, treatment, preventive measures, and dosage/duration for various drugs, including antimicrobial and ethnoveterinary medicine.

Focus on Poultry Health:

- **Diseases Covered**:
  - **Viral**: New Castle Disease, Avian Influenza, Marek's Disease, Fowl-pox, and more.
  - **Bacterial**: Avian Mycoplasmosis, E. coli infections, Salmonella, Infectious Coryza, Fowl Cholera.
  - **Parasitic**: Coccidiosis.

- **Biosecurity & Vaccination**: Emphasis on biosecurity practices to control pathogen spread, with detailed vaccination schedules for various poultry types (commercial layers, broilers, backyard poultry).

Goals and Impact:

- **Curbing Irrational Treatment**: Standardizes treatment practices to reduce misuse of veterinary drugs.
- **Antimicrobial Resistance (AMR)**: By regulating antibiotic use and focusing on preventive measures (e.g., vaccination, biosecurity), the SVTGs contribute to the fight against AMR—a growing threat to both animal and human health.
- **Policy Guidance**: Provides policymakers with a framework to assess the quality of veterinary medicines and animal health services, helping to inform budgetary decisions.

Antibiotic Resistance:

Medicines that are used to prevent and treat bacterial infections are called Antibiotics. Antibiotic resistance occurs when **bacteria change in response to the use of these medicines.** When we say antibiotic resistance, it means **bacteria are resistant to antibiotics** and not humans.

Antimicrobial Resistance:

It is a **broader term**, encompassing **resistance to drugs to treat infections caused by other microbes as well**, such as parasites, viruses, and fungi.

Antimicrobial resistance is the **resistance acquired by any microorganism** (bacteria, viruses, fungi, parasite, etc.) **against antimicrobial drugs** (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintics) that are used to treat infections.

As a result, **standard treatments become ineffective,** infections persist and may spread to others.

Microorganisms that develop antimicrobial resistance are sometimes referred to as **"superbugs".**

Reasons for Spread of Antimicrobial Resistance:

The **misuse of antimicrobials** in medicine and inappropriate use in agriculture.

Contamination around pharmaceutical manufacturing sites where untreated waste releases large amounts of active antimicrobials into the environment.

Understanding the Short-Lived Immunity of COVID-19 mRNA Vaccines: Challenges and Future Directions

Sub : Sci

Sec: Health

Why in News

COVID-19 mRNA vaccines have been groundbreaking, yet concerns are growing regarding the rapid decline in their effectiveness. Recent studies are shedding light on why these vaccines may not produce the **long-lasting immunity** seen in other vaccines. This article explores these findings and delves into the mechanisms behind **vaccine-induced immunity,** focusing on the role of **long-lasting plasma cells (LLPCs)** and implications for future vaccine development.

Rapid Waning of Immunity:

COVID-19 vaccines, especially mRNA-based ones, have shown a faster decline in immunity compared to many traditional vaccines. The main reason for this decline appears to be the lack of LLPCs in the bone marrow, which are essential for prolonged antibody production.

About Long-Lasting Plasma Cells (LLPCs):

LLPCs are vital for **long-term immunity** as they **continuously produce antibodies** against specific antigens, even without repeated exposure, contributing to **lasting protection** against diseases.

They develop from **activated B-cells** in structures called **germinal centres** found within **lymph nodes** and the **spleen,** a process often involving **helper T-cells** that aid in the **maturation and specialization** of these **plasma cells.**

After their formation, **LLPCs migrate to bone marrow "niches"** where they receive essential survival signals from surrounding **stromal cells and factors like APRIL (A Proliferation-Inducing Ligand),** allowing them to remain functional for years or even decades.

For effective vaccines, LLPCs are key as they provide the **durable antibody response** needed to **prevent re-infection.** However**, not all vaccines successfully induce LLPCs,** which is a focus of ongoing research for enhancing vaccine durability.

Distinction from Short-Lived Plasma Cells (SLPCs): Unlike SLPCs, which provide an immediate, **short-term antibody response and then die off,** LLPCs can maintain an antibody response over long periods without needing to re-encounter the antigen.

About Bone Marrow Niches: These specialized environments provide **crucial cytokines** and other factors that **ensure LLPCs remain active** and functional, a process essential to **long-lasting immunity.** Researchers are investigating ways to mimic these niches in vaccine designs to create more enduring immune responses.

Findings on COVID-19 Vaccine-Induced LLPCs:

A study published in *Nature Medicine* examined **LLPCs** in individuals who had received **COVID-19 mRNA vaccines.**

LLPCs were compared for COVID-19, influenza, and tetanus vaccines. COVID-19 vaccine-induced LLPCs were significantly lower than those for influenza and tetanus, indicating shorter immunity duration.

IgG and IgA Analysis: Antibody-secreting cells specific to different immunoglobulins (IgG and IgA) echoed these results, showing a deficiency in COVID-19-specific LLPCs.

About Antibody:

Antibody, also called **immunoglobulin, is a Y shaped protective protein** produced by the immune system in response to the presence of a foreign substance, called an antigen.

Antibodies **recognize and attack onto antigens in order to remove them** from the body.

Each tip of the "Y" of an antibody contains a paratope (analogous to a lock) that is specific for one particular epitope (analogous to a key) on an antigen, allowing these two structures to bind together with precision.

Using this binding mechanism, an antibody can tag a microbe or an infected cell and can neutralize it directly.

The main types of antibodies (immunoglobulins) include:

IgG. These are the most abundant types of antibodies in your plasma. They detoxify harmful substances and provide long-term protection.

IgM. These are the first antibodies made by B cells in response to antigens.

IgA. These antibodies collect antigens and remove them from your body in your mucus or other body fluids.

IgE. These antibodies trigger allergies and protect against parasites. Small amounts are in your skin, lungs, and mucosal membranes.

IgD. These antibodies bind to B cells and signal them to release IgM antibodies.

The Role of SARS-CoV-2 Spike Protein Structure

The **SARS-CoV-2** virus has spikes spaced around **20–25 nanometres** apart, which may **hinder B-cell receptor (BCR)** cross-linking—a process vital for generating LLPCs.

COVID-19 mRNA vaccines rely heavily on this spike protein as the primary immunogenic element. This spacing may partially explain why immunity from these vaccines fades more quickly.

Some researchers remain sceptical, suggesting **spike spacing might not fully account for the lack of LLPCs,** indicating that other factors could contribute to the waning immunity.

NPPA seeks cut in prices of anti-cancer medications

Sub :Sci

Sec: Health

Context:

- The **National Pharmaceutical Pricing Authority (NPPA)** has instructed manufacturers to lower the **maximum retail prices** of three significant **anti-cancer drugs: Trastuzumab, Osimertinib, and Durvalumab**.
- This action aligns with the government's goal of ensuring that essential medicines are available at affordable prices.

Waiver of customs duty:

- This directive follows the Union Budget 2024-25, where the government announced an exemption from customs duty for these three anti-cancer medicines.
- The **Department of Revenue, under the Ministry of Finance**, has recently issued a notification that reduces the **customs duty on these drugs to zero**.

About NPPA:

- National Pharmaceutical Pricing Authority (NPPA) was constituted as an attached office of the **Department of Pharmaceuticals (DoP)** in 1997 under **Ministry of Chemicals & Fertilizers** as an independent Regulator for pricing of drugs and to ensure availability and accessibility of medicines at affordable prices.
- It fixes ceiling prices of **scheduled essential drugs** and monitors Maximum Retail Prices (MRPs) of remaining non-scheduled medical devices, which have been regulated as drugs.

Eight Traditional Products of Assam's Bodo Tribe Granted GI Tag

Sub: Sci

Sec: IPR

Why in News

The **Geographical Indications (GI) Registry in Chennai** has granted **GI tags** to **eight traditional products** from Assam. This includes food items and traditional rice beer varieties produced by the **Bodo tribe**, marking a significant recognition of their cultural heritage.

Eight GI-Tagged Products

Traditional Rice Beer Varieties: The **Bodo Traditional Brewers Association** applied for GI tags for three unique varieties of rice beer made by the Bodo community. These include:

Bodo Jou Gwran: Contains the highest alcohol content among Bodo rice beers, around **16.11%**.

Maibra Jou Bidwi (Maibra Jwu/Zwu Bidwi): Served as a traditional **welcome drink** by Bodo tribes. Prepared by fermenting **half-cooked rice** with minimal water, using **'amao'** (a yeast source) to aid fermentation.

Bodo Jou Gishi: Another rice-based alcoholic beverage, traditionally fermented. Believed to have originated from **Lord Shiva**, and often consumed as a **medicinal drink** by the Bodo people.

Other GI-Tagged Products

Bodo Napham: A **fermented fish dish**, integral to Bodo cuisine, recognized with a GI tag.

Bodo Ondla: A **rice powder curry** flavored with **garlic**, **ginger**, **salt**, and **alkali**. Known for its unique flavor profile, this dish is another hallmark of Bodo culinary tradition.

Bodo Gwkha (Gwka Gwkhi): This dish is central to the **Bwisagu festival**, a major cultural event for the Bodo people. The GI tag underscores its cultural significance.

Bodo Narzi: A semi-fermented food prepared with **jute leaves (Corchorus capsularis)**. Rich in **Omega-3 fatty acids**, vitamins, and essential minerals like calcium and magnesium, making it a highly nutritious dish.

Bodo Aronai: A **beautifully woven cloth**, traditionally produced by **Bodo weavers**. It represents the textile heritage of the community and is often worn during important cultural occasions.

What are GI Tags?

GI tags are intellectual property rights granted by, **Geographical Indications Registry.**

GI tags have a duration, typically renewable after a certain period (e.g., every **10 years**) to maintain their validity and protection.

They indicate the specific geographical origin of a product. GI tags protect the product's unique qualities linked to its region.

Once granted, the GI tag is used as a label to certify the product's authenticity and origin.

Who provides GI Tags and under what law?

GI tags are provided by the **Geographical Indications Registry**, located in **Chennai, India**.

The registry operates under the **Geographical Indications of Goods (Registration and Protection) Act, 1999.**

Importance of GI Tags for Cultural Preservation: GI tags are instrumental in **preserving the heritage** and **uniqueness** of traditional products. They provide **legal protection** to the producers, help in **promoting local economies**, and boost **rural tourism**.

About Bodo Tribe: Believed to have arrived from **Tibet through Bhutan passes**, the Bodo community is one of the **earliest settlers** in the **Brahmaputra Valley** of Assam. The Bodos are the **largest minority** in Assam.

Cultural Richness: Known for their **rich culture**, including **traditional dance**, **music**, and **religious practices**, with **Bathouism** being a significant belief system.

Historically used the **Roman** and **Assamese scripts**, now the community has adopted the **Nagari script**.

Fond of their conventional rice beer called **Zu mai**.

Baishagu, celebrated annually in **April**, is their primary festival.

Breakthrough in Protein Design and Structure Prediction Wins 2024 Nobel Prize in Chemistry
Sub : Sci

Sec: Chemistry

Why in News

The **2024 Nobel Prize in Chemistry** was awarded jointly to **David Baker, Demis Hassabis, and John Jumper** for their ground breaking **contributions in computational protein design and structure prediction.** The award highlights advancements in the fields of **protein research** that have far-reaching implications for healthcare, pharmaceuticals, and molecular biology. The winners were announced by the **Swedish Academy of Royal Sciences**.

Historical Background:

In 1962, **John Kendrew and Max Perutz** won the **Nobel Prize** for discovering the **first 3D models of hemoglobin and myoglobin through X-ray crystallography.**

In 1972, **Christian Anfinsen** demonstrated that the **3D structure of a protein** is dictated by its **amino acid sequence.**

Scientists discovered that proteins do not randomly try different shapes before settling on their final form. Instead, **proteins seem to "know" their final shape and fold rapidly to acquire it.** This phenomenon is known as the **protein-folding problem**.

By the late 2010s, scientists had mapped the structures of around **1.7 lakh proteins, a fraction of the estimated 200 million proteins found in nature.** This landscape changed dramatically around 2018 with the advent of advanced computational tools.

What is AlphaFold?

AlphaFold is a revolutionary tool that **predicts the 3D structure of proteins,** developed by **DeepMind,** co-founded by **Demis Hassabis** in 2010 and acquired by Google in 2014.

AlphaFold 1 (2018): The original model could **predict the structure of almost any protein** based on known structures.

AlphaFold 2 (2020): Achieved accuracy comparable to X-ray crystallography in predicting protein structures.

AlphaFold 3 (2024): Led by **John Jumper,** this version expanded its capabilities to **predict interactions between proteins and between proteins and other molecules.**

AlphaFold is an **AI-based protein structure prediction tool**. It is based on a computer system **called deep neural network**. Inspired by the human brain**, neural networks use a large amount of input data and provides the desired output exactly like how a human brain would**.

The real work is done by **the black box between the input and the output layers, called the hidden networks**.

AlphaFold is **fed with protein sequences as input. When protein sequences enter through one end, the predicted three-dimensional structures come out through the other**. It is like a magician pulling a rabbit out of a hat.

How does AlphaFold work?

AlphaFold is an AI-based protein structure prediction tool. It used **processes based on "training, learning, retraining and relearning" to predict the structures of the entire 214 million unique protei**n sequences deposited **in the Universal Protein Resource (UniProt) database.**

About Proteins: Proteins are **large, complex molecules made of amino acids** that perform vital **biological functions.**

Proteins are composed of **one or more long chains of amino acids linked by peptide bonds.**

Proteins have **four levels of structure—primary, secondary, tertiary, and quaternary—**dictating their shape and function.

Proteins are involved in structural support, catalyzing reactions (enzymes), transport, immune defense, and cellular signaling.

Common types include **enzymes, antibodies, structural proteins (e.g., collagen), and transport proteins (e.g., hemoglobin).**

Proper folding into a **specific 3D shape is crucial for their functionality; misfolding can cause diseases.**

Proteins are **synthesized in cells by ribosomes** through a process called **translation, using mRNA as a template.**

Proteins are **broken down into amino acids via proteolysis,** allowing the **body to recycle amino acids.**

Proteins are involved in **every cellular process,** from **DNA replication to cell structure maintenance.**

About Amino Acids:

Amino acids are the basic units that make up proteins. There are **20 standard amino acids** used to build proteins in humans and most organisms.

Each amino acid consists of an **amino group (-NH2), a carboxyl group (-COOH), and a unique side chain (R-group).**

Out of the 20, **9 are essential and must be obtained through diet.** The remaining 11 amino acids can be synthesized by the body.

Amino acids are **linked together by peptide bonds to form proteins.** Amino acids play roles in **metabolism, enzyme function, and cell signalling.**

Amino acids are **encoded by the DNA sequence via codons in the genetic code.** Amino acids are crucial for **growth, repair, and maintaining body functions.**

The Haber-Bosch Process: A Revolution in Agriculture with Environmental Concerns

Sub :Sci

Sec :Chemistry

Why in News

The **Haber-Bosch process,** responsible for the mass production of **ammonia used in fertilizers,** has drastically impacted **global food production.** However, its environmental consequences and long-term sustainability have raised concerns among scientists and environmentalists.

The Chemistry Behind Nitrogen

Nitrogen in the air is mostly in the form of N_2, a molecule with a **triple bond** that is very difficult to break. Breaking this bond requires significant energy (946 kJ/mol).

Once the bond is broken**, nitrogen can form ammonia (NH_3) or nitrates,** which plants need to produce proteins, enzymes, and amino acids.

Nitrogen Cycle and Nitrogen Fixation

Nitrogen is an essential element **found in amino acids, proteins, hormones, chlorophyll, and vitamins.** It is a limiting nutrient in both natural and agricultural ecosystems, as plants and microbes compete for the nitrogen available in the soil.

Nitrogen exists in the atmosphere as N_2, held by a strong triple bond ($N \equiv N$). The conversion of nitrogen gas (N_2) to ammonia (NH_3) is called **nitrogen fixation**. In nature**, nitrogen can be fixed by lightning or ultraviolet (UV) radiation, forming nitrogen oxides (NO, NO_2, N_2O).**

Industrial combustion, forest fires, automobile exhaust, and power plants are major sources of nitrogen oxides in the atmosphere.

Ammonification: The decomposition of organic matter (dead plants and animals) releases ammonia, a process known as **ammonification**. Some of this ammonia returns to the atmosphere, while most undergoes nitrification in the soil.

Nitrification: In this process, **Nitrosomonas** and **Nitrococcus** bacteria first convert ammonia into nitrite, and **Nitrobacter** bacteria further oxidize it into nitrate. These bacteria are chemoautotrophs.

Denitrification: Nitrate in the soil can be converted back to nitrogen gas (N_2) through **denitrification**, performed by bacteria like **Pseudomonas** and **Thiobacillus**.

Lightning and Bacteria: In nature, **nitrogen fixation is primarily carried out by lightning or microorganisms like** *Azotobacter* **and** *Rhizobia*. These processes, however, contribute only around 10 kg of nitrogen per acre per year.

Azolla and Symbiosis: The **aquatic fern** *Azolla* **forms a symbiotic relationship with cyanobacteria,** converting atmospheric nitrogen into a form that can be used by plants.

Biological Nitrogen Fixation: Certain prokaryotes possess the enzyme **nitrogenase**, enabling them to fix atmospheric nitrogen. Nitrogen-fixing microbes can be **free-living** (e.g., **Azotobacter**, **Beijerinckia**, **Rhodospirillum**, **Anabaena**, **Nostoc**) or **symbiotic** (e.g., **Rhizobium**, **Frankia**).

Symbiotic Nitrogen Fixation: In leguminous plants (e.g., peas, beans, clover), **Rhizobium** bacteria form nodules on roots, where nitrogen is fixed. **Frankia** bacteria can also form nodules on non-leguminous plants like **Alnus**.

About Haber-Bosch Process:

The **Haber-Bosch process** is an industrial method for synthesizing **ammonia (NH_3)** from atmospheric nitrogen (N_2) and hydrogen (H_2). It plays a crucial role in the production of fertilizers, supporting global agriculture.

The process was developed by **Fritz Haber** (1909) and industrialized by **Carl Bosch** (1913).

Catalyst and Conditions: The reaction uses an **iron catalyst**, high temperatures (400-500°C), and high pressure (150-300 atm) to optimize ammonia production.

Raw Materials:

Nitrogen (N_2) is sourced from the air.

Hydrogen (H_2) is typically obtained from natural gas (methane, CH_4) through steam reforming.

The Haber-Bosch process is **critical for producing nitrogen-based fertilizers,** which have significantly boosted food production globally. It is credited with supporting nearly half of the world's population by increasing agricultural yields.

The **process is energy-intensive,** consuming about 1-2% of the world's energy supply, and contributes to **greenhouse gas emissions (CO_2)** during hydrogen production.

Apart from fertilizers, **ammonia produced via this process is used in explosives, cleaning products, and other chemical industries.**

Efforts are ongoing to develop greener alternatives, such as using **renewable energy** sources or improving process efficiency to reduce carbon emissions.

About Ammonia:

- **Ammonia is a colourless gas and is used as an industrial chemical in the production of fertilisers, plastics, synthetic fibres, dyes and other products.**
- It consists of **hydrogen and nitrogen.** In its aqueous form, it is called **ammonium hydroxide.**
- This **inorganic** compound has a pungent smell.
- **Occurrence:** Ammonia occurs naturally in the environment from the breakdown of organic waste matter.
- **It is lighter than air.**

Uses of Ammonia

- **About 80% of the ammonia produced by industry is used in agriculture as fertilizer.**
- **Ammonia is also used as a refrigerant gas, for purification of water supplies, and in the manufacture of plastics, explosives, textiles, pesticides, dyes and other chemicals.**
- It is found in many household and industrial-strength cleaning solutions. Household ammonia cleaning solutions are manufactured by adding ammonia gas to water and can be between 5 and 10% ammonia.
- **Ammonia solutions for industrial use may be concentrations of 25% or higher and are corrosive.**

Environmental Concerns:

- **Overuse of Fertilizers**: Modern farming practices often lead to the **overuse of nitrogen fertilizers,** with **percapita usage exceeding 50 kg in some countries.**
- **Global Average**: The global average nitrogen fertilizer usage is around 13 kg per capita.
- **Environmental Impact**: Excess nitrogen leads to:

- Soil Acidification: Nitrogen fertilizers increase **soil acidity, damaging ecosystems**.
- Water Pollution: Nitrogen runoff leads to **eutrophication in water bodies,** causing **oxygen depletion and algal blooms.**
- Air Pollution: Reactive nitrogen released into the atmosphere can **acidify rain and contribute to the destruction of natural landscapes.**

Food Insecurity Paradox: Despite the technological breakthrough, **food insecurity persists** due to political, economic, and social challenges.

Boeing 737 Rudder System Under Scrutiny: Safety Concerns and Investigations

Sub: Sci

Sec: Msc

Why in News

Certain variants of **Boeing 737 aircraft,** fitted with a **rollout guidance actuator,** have come under scrutiny due to concerns about a **potentially defective rudder control system.** This issue surfaced following an incident involving a **United Airlines Boeing 737-8 MAX flight** on February 6, 2024, and has **prompted safety alerts** by the **United States National Transportation Safety Board (NTSB).** In response, **India's Directorate General of Civil Aviation (DGCA)** has issued directives to Indian operators of **Boeing 737 aircraft.**

Boeing 737 aircraft:

The **Boeing 737** is a popular narrow-body aircraft, widely used by airlines for short- to medium-haul flights. It has undergone several updates since its introduction in the 1960s, with models ranging from the **737 Classic** to the more advanced **737 MAX.** The aircraft is known for its efficiency, reliability, and versatility

About Rollout Guidance Actuator:

The **rollout guidance actuator** is a **specialized component** found in some variants of the **Boeing 737,** particularly those equipped for advanced landing procedures. It plays a crucial role in controlling the aircraft's **rudder** during specific types of landings known as **Category III Instrument Landing System (ILS) approaches**, more specifically in **CAT IIIB Autoland operations**.

About Category (CAT) in Aviation:

CAT, or **Category**, in aviation refers to specific **Instrument Landing System (ILS) approach categories** defined by the level of precision and the visibility conditions under which an aircraft can land.

These categories range from **CAT I** to **CAT III**, with **CAT III having subcategories (A, B, and C)** that allow for **landing in progressively lower visibility conditions. These systems guide aircraft to land** safely using a combination of radio signals and, at times, ground-based lighting systems, especially when pilots have limited or no visibility.

CAT III is the most advanced ILS category, **used in very poor visibility conditions such as dense fog or heavy rain.** The **autoland system** and **rollout guidance actuators** are critical in these operations, as they allow aircraft to land and maintain directional control on the runway, even when pilots have little to no visual cues.

As CERN turns 70, it searches for ways to finance the next big thing

Sub :Sci

Sec: Nuclear sector

Context:

- **CERN**, the world-renowned particle physics lab, faces a significant challenge: securing **$17 billion** in funding for its next major project, the **Future Circular Collider (FCC)**.

About CERN:

- **CERN,** the **European Organization for Nuclear Research,** is **one of the world's largest** and most respected centres for scientific research.
- Founded in **1954**, **CERN'**s main focus is **particle physics** - the study of the **fundamental constituents of matter and the forces between them.**
- **Location:Geneva, Switzerland** (main site), straddling the **Franco-Swiss border**
- **Founded:** 1954
- **Member States:** 23 as of 2024, with several associate and observer states

Major Facilities:

- **Large Hadron Collider (LHC):**
  - The world's largest and most powerful particle accelerator
  - **27 km** circumference ring located **100m** underground

- Capable of colliding protons at energies up to **13 TeV**
- **ATLAS (A Toroidal LHC ApparatuS) and CMS (Compact Muon Solenoid):**
  - Two large general-purpose detectors used to look for signs of new physics
- **A Large Ion Collider Experiment (ALICE):**
  - Detector specialized for studying heavy-ion collisions
- **Large Hadron Collider beauty (LHCb):**
  - Detector for studying the slight differences between matter and antimatter
- **Other Accelerators:**
  - Proton Synchrotron (PS)
  - Super Proton Synchrotron (SPS)
  - Isotope Separator On-Line DEvice (ISOLDE) (for research with radioactive ions)

The Importance of Fundamental Research:
- **CERN's** work spans critical areas like **dark matter research** and **cosmic ray effects**, offering insights into the **universe's building blocks.**
- According to Gianotti, fundamental research drives innovation, and history shows that breakthroughs, like the **World Wide Web**, stem from such research.

Major Discoveries and Contributions
- **Discovery of the Higgs Boson (2012)**
  - Confirmed the existence of the **Higgs field**, which gives particles mass
- **Creation of Antimatter (1995)**
  - First creation of **anti-hydrogen atoms**
- **Discovery of W and Z Bosons (1983)**
  - Confirmed the electroweak theory
- **Invention of the World Wide Web (1989)**
  - Tim Berners-Lee developed the **WWW** to help scientists share information
- **Advancements in Superconducting Magnets**
  - Crucial for the operation of the LHC and with applications beyond particle physics

Plans for the Future Circular Collider:
- The **FCC** is set to be a **90-kilometer** underground ring beneath **France** and **Switzerland**, far **larger** than the **LHC's 27-kilometer ring.**
- A **feasibility study** will conclude in **2025**, and a decision on construction is expected by **2027** or **2028**.

Geopolitical Competition in Particle Physics:
- Europe risks losing its leadership in particle physics to **China**, which has the resources and ambition to build a rival **collider.**
- Former **European Central Bank President Mario Draghi** highlighted CERN's leadership as a **critical success** for the **EU in particle physics.**
- Should China complete its **circular collider** first, **Europe'**s dominance could be jeopardized.

Nobel Peace Prize 2024: Honouring N-bomb Survivors and the Disarmament Movement
Sub: Sci

Sec: Nuclear sector

Why in News
- The **2024 Nobel Peace Prize** was awarded to **Nihon Hidankyo,** a Japanese organization representing survivors of the atomic bombings in **Hiroshima and Nagasaki.** This recognition brings attention to the global movement for **nuclear disarmament** and the significant role played by the survivors, known as **"Hibakusha,"** in raising awareness about the catastrophic humanitarian consequences of nuclear weapons.

About Nihon Hidankyo:
- The **Nobel Peace Prize for 2024** was awarded to **Nihon Hidankyo,** the **only nationwide organization representing survivors of the atomic bomb attacks on Hiroshima and Nagasaki in 1945.**
- **Nihon Hidankyo** was recognized for its **continuous efforts to achieve a nuclear-weapon-free world.** The organization has contributed immensely to **raising awareness about the humanitarian costs of nuclear weapons.**

- **Since 1901, at least 10 Nobel Peace Prizes** have been awarded for contributions to the **cause of nuclear disarmament**. Previous recipients include **Japanese Prime Minister Eisaku Sato in 1974,** credited for maintaining **Japan's non-nuclear stance,** and the **International Campaign to Abolish nuclear weapons (ICAN) in 2017,** recognized for its work towards a treaty-based prohibition of nuclear weapons.

About Hibakusha:

- Hibakusha is a Japanese term meaning **"bomb-affected people."** It refers to the **survivors of the atomic bombings in Hiroshima and Nagasaki during World War II (1945).**

- Hibakusha experienced **severe health effects, including radiation sickness, cancer, and genetic damage.** Many **suffered long-term psychological trauma.**

- Hibakusha have been at the forefront of the **global movement to abolish nuclear weapons.**

- Their efforts contributed to the establishment of a **nuclear taboo, preventing** the use of **nuclear weapons since 1945.**

- The term **"nuclear taboo"** refers to **the global reluctance to use nuclear weapons since 1945,** largely due to the devastating consequences witnessed in Japan.
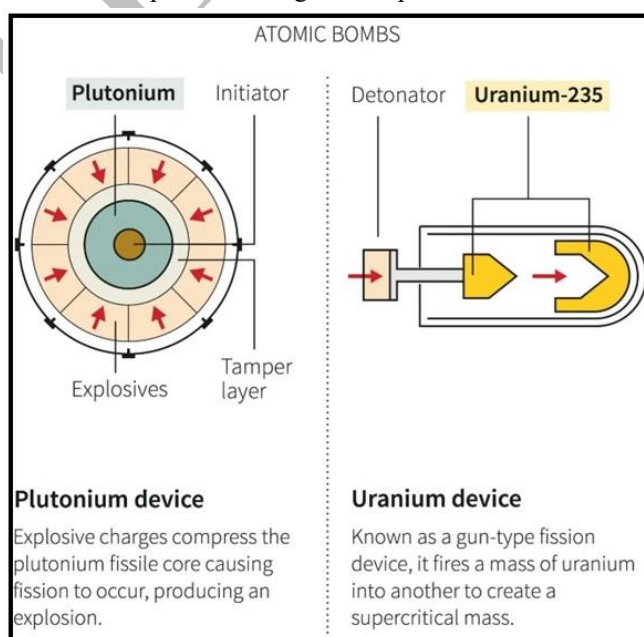
Background on Atomic Bombings (1945)

- **Hiroshima Bombing (August 6, 1945)**: The United States dropped the first atomic bomb, **"Little Boy,"** on Hiroshima, killing over 70,000 people instantly. The total death toll crossed 100,000 in the following weeks.

- **Nagasaki Bombing (August 9, 1945)**: A second bomb, **"Fat Man,"** was dropped on Nagasaki, killing around 40,000 people instantly, with thousands more dying due to after-effects in the weeks that followed.

About Atomic Bomb

- The atomic bomb is also known as A-bomb, atom bomb, nuclear bomb, or nuclear warhead.

- The atomic bomb gets its destructive property from nuclear fission reactions or from the **combination of nuclear fission or fusion reactions**.

- **Nuclear fission:** It is a process in which the **nucleus of an atom splits into two or smaller nuclear fission products and usually some by-product particles.** Hence, fission is a form of **elemental transmutation.**

- Atomic bombs too **release an enormous amount of energy when exploded and cause mass destruction.**

- This explosion is caused due to the **nuclear fission reaction where the splitting of nuclei of a heavy element like uranium, and plutonium takes place**

The Explosion of Atomic Bomb:

- When the **neutron strikes the nucleus of a uranium-235 or plutonium-239 isotope,** it causes the nucleus of the **atom to split into two fragments,** each of which is a nucleus with about **half the protons and neutrons of the original nucleus.**

- When the splitting takes place, **a high amount of heat, gamma rays,** as well as two or more neutrons are released.

- Under certain conditions, the **neutrons are made to fission more with uranium nuclei,** which then emit more neutrons that split more nuclei. This series multiplies, resulting in an explosion.

ATOMIC BOMBS

Plutonium Initiator   Detonator **Uranium-235**

Explosives   Tamper layer

Plutonium device
Explosive charges compress the plutonium fissile core causing fission to occur, producing an explosion.

Uranium device
Known as a gun-type fission device, it fires a mass of uranium into another to create a supercritical mass.

Why Big Tech Companies are Exploring Nuclear Power for Energy Needs

Sub: Sci

Sec: Nuclear

Why in News

Big tech companies like **Google, Microsoft, and Amazon are exploring nuclear energy,** specifically **Small Modular Reactors (SMRs),** to power their energy-intensive operations such as **AI training, data centers, and online services.** These companies are recognizing nuclear energy as a potential source of clean, round-the-clock, carbon-free power.

Growing Energy Demands of Big Tech

Training AI models, ensuring constant online services, and maintaining **large-scale data centres require enormous amounts of energy.** In 2023, **Google's total global greenhouse gas emissions increased by 13%,** reflecting the challenges of reducing emissions amidst growing computational demands.

Why Nuclear Energy?

Nuclear energy is seen as **clean, carbon-free, and available round-the-clock,** unlike solar and wind energy, which are intermittent. **Small Modular Reactors (SMRs),** with their smaller sizes and modular designs, allow for faster deployment and can cater to the energy needs of tech companies efficiently.

What are Small Modular Reactors (SMRs)?

- SMRs are nuclear reactors with a **maximum capacity of 300 MW,** designed for **modularity and flexibility**.
- Unlike conventional NPPs, which have larger capacities, SMRs offer **enhanced safety, scalability, and ease of deployment**.
- SMRs often have **passive safety features**, simplified designs, and **reduced potential for radioactive material release.**
- Their smaller size allows for **modular construction and potentially shorter construction timelines.**
- SMRs can be installed at **brownfield sites and repurpose existing infrastructure,** reducing land acquisition challenges associated with larger NPPs.
- These differences make SMRs particularly suited for supporting grid stability, complementing intermittent renewables, and enhancing energy security.
- SMRs boast improved safety through **innovative design features,** leading to a lower likelihood of core damage and contamination.
- The **reduced amount of spent nuclear fuel generated by SMRs** simplifies waste management and reduces long-term storage requirements.
- Higher capacity factors and **extended operational lifespans** enhance their economic viability.
- According to the **U.S. Nuclear Regulatory Commission**, SMRs can potentially operate for up to 60 years, maintaining high-capacity factors.

Concerns Surrounding Nuclear Energy:

- Public perception of nuclear energy is tainted by historic disasters like **Ukraine's Chernobyl (1986) and Japan's Fukushima (2011).** These incidents had long-term environmental and health impacts, which still influence public opinion on nuclear power.
- **In 1979, the Three Mile Island accident in the U.S.** was caused by **human error and equipment malfunction, releasing radioactive gases.** Although it had limited impact on the population, it is considered one of the worst nuclear incidents in U.S. history.
- Organizations like **'Friends of the Earth'** argue that nuclear energy is dangerous, expensive, and has a history of accidents and leaks. They also highlight concerns about **nuclear plants being built in earthquake-prone regions.**

How tardigrades are able to resist high levels of radiation

Sub : Sci

Sec: Nuclear sector

Context: Recent research has identified **genetic mechanisms** in a newly discovered species of tardigrade, **Hypsibius henanensis**, that enable it to **withstand high levels of radiation**.

- This study has implications for various fields, including space exploration and cancer treatment.

About the study:

- The research was published in the journal **Science** and involved multiple institutions in China.
- The study titled **Multi-omics landscape and molecular basis of radiation tolerance in a tardigrade** highlights how certain genes become more active when exposed to radiation, protecting and repairing the DNA of these microscopic animals.

Methodology of the study:

- The research team discovered **Hypsibius henanensis** six years ago after collecting moss samples from **Funiu Mountain** in Henan province, China.
- They sequenced the genome of this new tardigrade species, revealing a total of **14,701 genes**, with **30% unique** to tardigrades.
- The team exposed the tardigrades to **gamma rays** at doses significantly higher than what humans can tolerate.

Key findings:
- The researchers identified **2,801 genes** associated with DNA repair in **Hypsibius henanensis**.
- Three primary factors contributing to radiation tolerance were noted:
- **Rapid DNA repair**: The species can quickly repair double-strand breaks in DNA, utilizing a protein called **TRID1**.
- **Gene activation**: Upon radiation exposure, a specific gene was activated that produces two proteins essential for **mitochondrial synthesis**, which also play a role in DNA repair.
- **Antioxidant production**: The tardigrade can produce **betalains**, antioxidant pigments that neutralize harmful reactive chemicals generated by radiation within cells.
- The researchers tested one of the tardigrade's betalains on human cells and found it significantly improved their survival rate after radiation exposure.

Significance of the findings:
- The genetic insights gained could help in **protecting astronauts from radiation in space** missions, **aid in cleaning up nuclear pollution**, and **improve radiation therapy** for cancer patients.
- This discovery may help improve the stress tolerance of human cells, benefiting patients undergoing radiation therapy.

About tardigrades:
- Tardigrades, also known as **water bears or moss piglets**, are **microscopic, water-dwelling organisms** that are renowned for their remarkable **resilience to extreme environmental conditions**.
- They often thrive in extreme conditions, including high altitudes and deep-sea environments.
- Tardigrades have a plump, **segmented body with eight legs,** each ending in claws or suction pads.
- They can **survive in a desiccated state for years**, rehydrating and resuming activity when conditions improve.

Why we shouldn't worry (too much) about an asteroid hitting Earth
Sub: Sci

Sec: Space sector

Context:
- **2024 ON, an asteroid** the size of the Eiffel Tower and shaped like a peanut, was deemed **potentially hazardous** but posed **no actual threat to Earth.**
- It measured **370 meters in diameter** and traveled at **40,000 kilometers per hour**.
- Despite dramatic headlines, astronomers calculated that **2024 ON** would pass by Earth at a safe distance of **one million kilometers**, more than twice the distance to the moon.

Near-Earth Objects (NEOs)
- **Definition**:
  - **According to the United Nations Office for Outer Space Affairs, NEOs** are **asteroids or comets** that pass close to **Earth's orbit,** with a **perihelion** (closest distance to the sun) of less than **195 million kilometers**.
  - Earth's orbit is **150 million kilometers** from the sun, meaning **NEOs** are within our solar neighborhood.
- **Known NEOs**:
  - Scientists have cataloged around **34,000 NEOs**, and none of the larger ones are currently on a collision course with Earth.

Asteroid Impact Likelihood:
- **Smaller NEOs**:
  - Tiny NEOs hit Earth daily, but **larger impacts** are rare. An asteroid the size of 2024 ON might hit Earth **once every 10,000 years**.
- **Larger Asteroids**:
  - Around **100 tons of space debris** hits Earth daily, though it consists mostly of tiny rocks that don't cause harm.
  - Objects **larger than 1 kilometer** in diameter, like the asteroid that caused the **dinosaur extinction**, might impact Earth every **260 million years**.
  - Only **5%** of such large objects remain undiscovered.

- - - Even smaller NEOs, around **40 meters in width**, can cause significant damage if they enter Earth's atmosphere at high speeds.

Finding and Tracking NEOs

- **NEOWISE telescope** has discovered **over 158,000 NEOs** before it was retired in **2024**.
- Its successor, the **NEO Surveyor**, is set to begin in **2027**, aiming to find more hazardous asteroids.
- The upcoming **Vera Rubin Observatory (Ground-Based Telescope)** in **Chile** will provide a **time-lapse map of the universe,** significantly improving asteroid discovery rates.
- The **ESA's Flyeye telescopes** will also contribute to tracking asteroids by making wide-field observations of the night sky.
- Detecting NEOs is difficult because it's hard to gauge how far away objects are from Earth.

NASA's DART Mission:

- In **2022**, **NASA** successfully tested its **Double Asteroid Redirection Test (DART)** by crashing a spacecraft into an asteroid to change its trajectory.
- **ESA** will launch **Hera** in **October 2024** to further study **DART's impact** and help refine planetary defense strategies.
- The asteroid **Apophis**, once considered a significant threat, will pass close to Earth in **2029**, but updated calculations show it won't hit the planet.

How Europe's creating the moon on Earth

Sub : Sci

Sec: Space

LUNA Analog Facility: Simulating the Moon on Earth

- Developed by the **German Space Agency (DLR)** and **European Space Agency (ESA),** the **LUNA Analog Facility** was unveiled in **September 2024.**
- Its purpose is to **recreate the moon's environment** for training astronauts and testing new technologies.
- **Key components include:**
  - **Artificial lunar soil (regolith)** from volcanic soils of Italy, Germany's Eifel region, and Norwegian rocks.
  - **Special lighting** to simulate the sun's angle and harsh shadows astronauts would face on the moon.

Challenges in Simulating the Moon:

- One crucial element, **lunar gravity**, is missing from the facility. On the moon, **gravity is one-sixth that of Earth.**
- Unlike **parabolic flights** or **swimming pools**, which simulate **zero-gravity**, **LUNA's land-based setup** makes this hard to achieve.
  - **Parabolic flights** use **refitted jet aircraft** to recreate the **loss of gravity** by ascending to and descending from high altitudes at 45-degree angles.
  - Astronaut training **swimming pools** are also specially equipped, and the astronauts perform mock exercises in spacesuits.
- **Proposed solution**: Engineers plan to develop a **"gravity offload system"**, where astronauts are suspended by cables to **mimic moon-like gravity.** This system is still in the prototype phase.

Training Exercises:

- During the unveiling, astronauts Matthias Maurer and Thomas Pesquet conducted mock lunar missions in front of officials, using long-handled scoops, a sample trolley, and a robotic dog.
- Although they could not experience moon-like gravity, the facility replicates the **difficult lighting and terrain** conditions astronauts will encounter on the real moon.
- **Regolith's challenges**: **Lunar soil is highly abrasive**, potentially damaging all electrical equipment and spacesuits. Testing these effects is a key part of **LUNA's purpose**.
- **LUNA** has room for further development, with additional modules nearby for habitat simulation and food cultivation (from the **EDEN ISS experiment**).
- Future plans include the possibility of a **"LUNA 2"** for **Mars training.**

Global Connectivity:

- **LUNA** can connect to mission control centers worldwide, allowing remote simulations. NASA astronauts could be guided through a mission simulation in **Germany** by teams in the US.
- According to ESA officials, the **LUNA facility** signals **Europe'**s serious commitment to space exploration, supporting both **NASA's Artemis program** and Europe's goal of reaching the moon by the **2030s**.

EDEN ISS experiment:

- The goal of the **EDEN ISS project** is to advance **controlled environment agriculture technologies** beyond the state-of-the-art.
- It focuses on **ground demonstration of plant cultivation technologies** and their **application in space**.
- **EDEN ISS** develops **safe food production** for onboard the **International Space Station (ISS)** and for **future human space exploration vehicles and planetary outposts.**
- **EDEN ISS** develops an **advanced nutrient delivery system, a high performance LED lighting system, a bio-detection and decontamination system** and **food quality and safety procedures and technologies.**
- A **mobile container-sized greenhouse test facility** was built to demonstrate and validate different key technologies and procedures necessary for safe food production within a (semi-) closed system.

PSLV-C37 Upper Stage Re-Entry after Seven Years: ISRO's Historic Mission

Sub: Sci

Sec: Space sector

Why in News

- The **Indian Space Research Organisation (ISRO)** announced the **atmospheric re-entry** of the upper stage of the **Polar Satellite Launch Vehicle (PSLV) C-37 mission on October 6, 2024.** This marks the completion of the **PSLV-C37 mission, launched in 2017, which set a world record for deploying 104 satellites in a single launch.** The re-entry event signifies ISRO's commitment to international space debris mitigation guidelines.

About PSLV-C37 Mission:

The **PSLV C37** mission, launched by ISRO on **February 15, 2017**, set a world record by deploying **104 satellites** in a single mission. The primary satellite onboard was **Cartosat-2D**, an Earth observation satellite, accompanied by **103 smaller satellites** from countries such as the USA, Israel, Kazakhstan, the UAE, and the Netherlands. Out of the 104, **96 satellites were from the USA**.

Launch Site: **Sriharikota, India**

Co-passenger Satellites: 103 satellites, including **INS-1A, INS-1B, Al-Farabi 1, BGUSAT, DIDO-2, Nayif 1, PEASS, 88 Flock-3p satellites, and 8 Lemur-2 satellites.**

Historical Achievement: ISRO made history by deploying 104 satellites in a single mission, **the first of its kind globally.**

Upper Stage Name: **PS4** (Polar Satellite Launch Vehicle's fourth stage)

Orbit Details: After mission completion, the **PS4 upper stage was left in an orbit** of approximately 470 x 494 km.

Tracking: The upper stage was tracked by **U.S. Space Command (USSPACECOM) under NORAD ID 42052.**

About PSLV

- PSLV stands for **Polar Satellite Launch Vehicle**. It's an expendable launch vehicle developed by the **Indian Space Research Organization (ISRO)** to launch satellites into polar orbits.
- **PSLV's first launch was in 1994,** and it has been ISRO's main rocket ever since. Today's PSLV, however, is vastly improved and several times more powerful than the ones used in the 1990s.
- It is the **first Indian launch vehicle** to be equipped with **liquid stages.**
- PSLV is the **most reliable rocket** used by ISRO till date, with **52 of its 54 flights being successful.**
- It successfully launched two spacecraft – **Chandrayaan-1**in 2008 and Mars Orbiter Spacecraft in 2013 – that later traveled to Moon and Mars respectively.
- It has been used for a **wide range of missions, including launching Earth observation satellites, communication satellites**, and scientific payloads into polar orbits around the Earth.

Key features about the PSLV:

Variants: The PSLV comes in various configurations, including **the PSLV-G (standard version), PSLV-CA (Core Alone), and PSLV-XL (extended version).** Each variant is tailored for specific mission requirements.

Payload Capacity: The PSLV can carry payloads ranging from a few hundred kilograms to over a ton, depending on the specific variant and mission requirements.

Versatility: It is known for its adaptability and ability to launch satellites into a variety of orbits, **including polar orbits, geostationary transfer orbits (GTO), and sun-synchronous orbits (SSO).**

Reliability: The PSLV has earned a **reputation for its reliability and cost-effectiveness,** making it a popular choice for satellite launches not only for Indian payloads but also for international customers.

Notable Missions: The PSLV has conducted several remarkable missions, including the **Mars Orbiter Mission (Mangalyaan) in 2013** and the launch of numerous small and large satellites for various purposes.

Contributions: It has played a crucial role in India's space program and has been instrumental in **Earth observation, remote sensing, navigation, and communication satellite deployments.**

Compliance with International Guidelines

Debris Mitigation Guidelines: The re-entry of PSLV-C37's upper stage was **fully compliant with the guidelines set by the Inter-Agency Space Debris Coordination Committee (IADC).**

IADC Guidelines: These guidelines recommend **that defunct objects in low-Earth orbit (LEO) should have a post-mission orbital life of no more than 25 years to mitigate space debris.**

IADC (Inter-Agency Space Debris Coordination Committee): An international organization that provides guidelines for reducing space debris and ensuring the long-term sustainability of space activities.

Safe Re-entry: ISRO ensured the re-entry adhered to international space sustainability norms, further affirming India's dedication to responsible space operations.

IS4OM (ISRO's System for Safe and Sustainable Space Operations Management): A system developed by **ISRO to ensure the safety and sustainability of its space operations,** including tracking space objects and monitoring potential threats.

Why SpaceX 'catching' Starship booster with robotic arms is significant

Sub: Sci

Sec: Space sector

Context:

- A pair of giant robotic arms caught the more than **70-metre-long first-stage booster of SpaceX's Starship**, bringing **SpaceX** a step closer to its goal of **building a fully and rapidly reusable rocket system.**

About the Mission:

- **Launch**: The fifth test launch took place at **Starbase in Boca Chica, Texas**, at 7:25 AM local time.
- **Super Heavy Booster**: Equipped with **33 methane-burning Raptor engines**, it propelled the **Starship spacecraft into orbit.**
  - After detaching, the booster **returned to Earth** and was **caught mid-air** by the **"Mechazilla"** gantry arms, marking a significant step toward **reusability.**
  - Instead of splashing into the ocean like most rockets, the booster was safely recovered at the launch site.
- **Starship Spacecraft**: Powered by **six Raptor engines**, it continued to space, completing **one Earth orbit** before a controlled splashdown in the Indian Ocean.

Why Was This Mission Significant?

- **Reusability**: Most rockets are **expendable**, used only once, making space travel expensive and time-consuming. SpaceX aims to create a **fully reusable system**.
  - The successful catch of the **Super Heavy booster** demonstrates progress toward this goal.
  - **Vision**: Elon Musk envisions a system where Starship could be rapidly reused, with the rocket restacked and ready for another launch in as little as **30 minutes**.
- **Innovation**: SpaceX has already mastered landing its **Falcon 9** rockets, but catching the massive Super Heavy booster in mid-air is a new technological feat.

What is Starship?

- **Starship** is **SpaceX's two-stage heavy lift vehicle** designed for **crewed and cargo missions** to **Earth orbit, the Moon, Mars, and beyond.**
  - **Two stages**: The **Super Heavy** booster (first stage) and the **Starship spacecraft** (upper section).
  - **Size**: Nearly **120 meters tall,** it is the **largest rocket ever built,** surpassing the **Saturn V (111 meters),** which took humans to the Moon.
  - **Goal**: To create a **fully and rapidly reusable rocket system,** revolutionizing space travel by drastically reducing costs.

Importance of Starship for Space Travel:

- **Future missions**: Starship is crucial for SpaceX's plans to transport astronauts and cargo to the Moon, Mars, and beyond.
  - NASA has contracted SpaceX to use **Starship HLS (Human Landing System)** for the **Artemis III mission**, which aims to land astronauts on the **Moon by 2026.**
  - **Mars ambitions**: SpaceX hopes that Starship will eventually be the vehicle to put the first humans on Mars.
- **Challenges**: While reusable systems lower costs, ensuring that Starship is safe and reliable is a critical challenge, as shown by past experiences like NASA's **Space Shuttle** program, which struggled with high maintenance costs despite being partially reusable.

Jiangmen Underground Neutrino Observatory (JUNO): China's Leap Toward Solving Neutrino Mysteries

Sub: Sci

Sec: Space tech

Why in News

China's **Jiangmen Underground Neutrino Observatory (JUNO)**, located in southern Guangdong, is nearing completion and is set to revolutionize our understanding of **neutrinos**, subatomic particles key to unlocking many cosmic mysteries. With global collaboration, JUNO is expected to provide groundbreaking insights into neutrino behaviour, mass hierarchy, and their impact on fundamental physics.

About JUNO and Its Purpose

- JUNO is located **700 meters underground in China's Guangdong province.**
- A **giant sphere** equipped with thousands of light-detecting tubes will be housed within a **12-storey cylindrical pool of water**.
- The experiment aims to study elusive **subatomic particles known as neutrinos**, products of nuclear reactions.
- JUNO will focus on determining the **mass hierarchy of neutrinos**, providing insights into the universe's subatomic processes and matter formation.
- JUNO will observe **solar neutrinos**, providing real-time data on solar processes. It will also study **neutrinos released by the radioactive decay of elements like uranium and thorium in the Earth**, helping researchers understand **mantle convection** and **tectonic plate movement**.
- **Global Collaboration**: JUNO involves scientists from **France, Germany, Italy, Russia, the U.S., and Taiwan**. JUNO's research will be a collaborative effort involving data sharing and analysis across countries.
- **Operational Timeline**: Set to begin operation by **late 2025**, JUNO will surpass other major neutrino observatories, including the **Deep Underground Neutrino Experiment (DUNE)** in the U.S., which is still under construction.

What are neutrinos?

- Neutrinos are the **second most abundant particles in the world, after photons,** or the light particle.
- Neutrinos are **mysterious particles,** produced copiously in nuclear reactions in the **Sun, stars, and elsewhere.**
- **Neutrinos** are tiny, near-massless particles produced by nuclear reactions. Every second, trillions pass through matter, including the human body.
- They also **"oscillate"**–meaning that different types of neutrinos change into one another. Probing of oscillations of neutrinos and their relations with mass are crucial in studying the origin of the universe.
- Neutrinos are **created by various radioactive decays**; during a supernova, by cosmic rays striking atoms etc.
- There are **three known varieties of neutrinos**, and they can **transform** from one type to another mid-flight. Understanding which type is the lightest or heaviest could explain processes from the universe's early days and why matter exists in its current form.
- JUNO will track **neutrinos emitted from nearby Guangdong nuclear power plants**, focusing on neutrino transformation, or **oscillation**, to solve the **neutrino mass hierarchy problem**.

Black Holes in Early Universe Data: Revisiting the Standard Cosmological Model

Sub : Sci

Sec: Space sector

Why in News

Recent studies using data from the **James Webb Space Telescope (JWST)** raised questions about the **standard cosmological model,** suggesting that massive galaxies existed earlier than previously believed. A new study published on August 26 in the *Astrophysical Journal* provides a possible explanation, which could protect the standard model from being revised.

The Standard Model of Cosmology

The universe, originating from the **Big Bang 13.8 billion years ago,** gradually cooled and allowed the **formation of matter into stars and galaxies.**

According to the **standard model,** stars first appeared **100-200 million years post-Big Bang,** and galaxies within a billion years. JWST's data showing well-developed galaxies earlier posed a challenge to this understanding.

The study also highlights that **massive black hole,** often referred to as **"little red dots"** due to their faint light, significantly contribute to the total light emitted by galaxies.

Previous studies may have overestimated the mass of stars in these galaxies due to the additional light from black holes. When this factor was corrected in the new analysis, the galaxies were found to be less massive, **aligning with the predictions of the standard model.**

About Black Holes:

Black holes are mysterious cosmic objects, often misunderstood. **They are not actual holes but incredibly dense concentrations of matter.**

It is typically formed during **supernova explosions.**

A black hole's **event horizon**, just beneath its surface, has such **intense gravity that nothing, not even light, can escape it**.

This **event horizon** contains all the matter that makes up the black hole.

Black holes are **invisible to telescopes** because **they do not emit or reflect light**. Scientists detect and study them through various means:

Accretion disks: Rings of gas and dust around black holes emit light, including **X-rays.**

Stellar orbits: Intense gravity from supermassive black holes causes stars to orbit them uniquely.

Gravitational waves: Massive objects create ripples in space-time when they accelerate, which scientists can detect.

Gravitational lensing: Black holes can bend and distort light from distant objects, revealing their presence.

Closest: The nearest known black hole, **1A 06200-00**, is **3,000 light-years** away.

Farthest: In the galaxy, **QSO J0313-1806**, is about **13 billion light-years away**.

Biggest: **TON 618**, is **66 billion times the mass of the Sun**.

Smallest: The lightest-known black hole is **only 3.8 times the Sun's mass** and is **paired with a star.**

Spaghettification: The process by which (in some theories) an object would be stretched and **ripped apart by gravitational forces on falling into a black hole**.

It's squeezed horizontally and stretched vertically, resembling a **noodle**.

Spin: All black holes spin, with the fastest-known, **GRS 1915+105**, rotating over **1,000 times per second.**

Particle accelerators: Monster black holes at galaxy centers can launch particles to nearly light speed.

Not so rare: Most Milky Way-sized galaxies have supermassive black holes at their centers, such as **Sagittarius A***, which is **4 million times the mass of the Sun.**

About James Webb Space Telescope (JWST):

- Largest and most powerful telescope in space.
- It has a huge mirror that is **five times bigger than** that of its predecessor, the **Hubble Space Telescope.**
- JWST was launched on Christmas Day in 2021 and arrived at its destination, the **Sun-Earth Lagrange point 2** in January 2022
- The telescope has been looking at the **early epochs in the history of the Universe**, when the first galaxies had barely formed.
- Its images were, however, **very different from what astronomers had thought** they would see.
- The **James Webb Space Telescope (JWST or "Webb") is a joint NASA–ESA–CSA** space telescope that is planned to succeed the Hubble Space Telescope as NASA's flagship astrophysics mission.
- The **JWST will provide improved infrared resolution and sensitivity over Hubble**, and will enable a broad range of investigations across the fields of astronomy and cosmology, including observing some of the most distant events and objects in the universe, such as the formation of the first galaxies.
- **JWST will study various phases in the history of the universe, from the formation of solar systems to the evolution of our own Solar System.**
- The James Webb Space Telescope (sometimes called JWST or Webb) is an orbiting infrared observatory that will complement and extend the discoveries of the Hubble Space Telescope, with longer wavelength coverage and greatly improved sensitivity.

4300 tonnes of space junk and rising: Another satellite breakup adds to orbital debris woes

Sub: Sci

Sec: Space sector

Context:

- A major **communications satellite, Intelsat 33e,** has broken up in orbit, impacting users in **Europe, Central Africa, the Middle East, Asia,** and **Australia,** while adding to the growing amount of **space debris.**

Details about Intelsat 33e:

- Launched in **August 2016** by **Boeing.**

- Operated in **geostationary orbit, 35,000 km** above the **Indian Ocean.**

- Experienced significant technical problems since 2017, including issues with its primary thruster and fuel consumption, leading to an insurance claim of **$78 million.**

- It was not insured at the time of its breakup, which occurred after a sudden power loss on October 20, 2024.

Breakup Confirmation:

- **U.S. Space Forces** confirmed the satellite broke into at least **20 pieces**.
- **No confirmed cause** for the breakup yet, though it could be due to past technical issues or external factors like collisions or solar activity.

Space Debris Concerns:

- The **European Space Agency (ESA)** estimates there are over **40,000 pieces of debris larger than 10 cm** and **130 million smaller than 1 cm** orbiting Earth.
- **Total mass of human-made objects** in orbit is about **13,000 tonnes,** one-third of which is debris.
- **Intelsat 33e**'s breakup likely produced debris too small to track, adding to the growing concern over space junk.

Recent Similar Incidents:

- **June 2024: RESURS-P1 satellite** fractured, producing over 100 trackable pieces.
- **July 2024: Defense Meteorological Satellite Program (DMSP) 5D-2 F8** spacecraft broke up.
- **August 2024:** Upper stage of a **Long March 6A rocket** fragmented, generating over 283 trackable debris pieces.

Responsibility for Space Debris:

- According to the **1972 Convention of International Liability for Damage Caused by Space Objects,** the **launching country is responsible for debris**.
- In practice, accountability is often lacking. The **U.S.** issued its first fine for space debris in **2023,** though it's unclear if similar action will follow for Intelsat 33e.

1972 Convention of International Liability for Damage Caused by Space Objects (Liability Convention):

- The **Liability Convention** was considered and negotiated by the Legal subcommittee from 1963 to 1972.
- Agreement was reached in the General Assembly in **1971**, and the **Convention entered into force** in **September 1972.**
- As of **1 January 2021, 98 States** have **ratified** the **Liability Convention, 19** have **signed but not ratified** and **four international intergovernmental organizations** (the European Space Agency, the European Organisation for the Exploitation of Meteorological Satellites, the Intersputnik International Organization of Space Communications, and the European Telecommunications Satellite Organization) have **declared their acceptance** of the rights and obligations provided for in the Agreement.
- **India** has signed and ratified the convention.
- **Key provisions:**
  - Elaborating on **Article 7** of the **Outer Space Treaty,** the **Liability Convention** provides that a launching State shall be absolutely liable to pay compensation for damage caused by its space objects on the surface of the Earth or to aircraft, and liable for damage due to its faults in space.
  - The Convention also provides for procedures for the settlement of claims for damages.
  - If **two states** work together to **launch a space object,** then **both of those states are jointly and severally liable** for the damage that object causes. This means that the injured party can sue either of the two states for the full amount of damage.
  - Claims under the Liability Convention must be brought by the state against a state.

ISRO-DBT Agreement to Conduct Biotechnology Experiments in Space Station

Sub: Sci

Sec: Space sector

- **Agreement between ISRO and DBT:**
  - The **Indian Space Research Organisation (ISRO)** and the **Department of Biotechnology (DBT)** have signed an agreement to collaborate on designing and conducting biotechnology experiments.
  - These experiments will be integrated into the upcoming **Bharatiya Antariksh Station (BAS)**, India's planned indigenous space station.
- **Bharatiya Antariksh Station (BAS):**
  - The BAS is expected to be operational between **2028 and 2035**, marking India's foray into establishing a permanent space station.
  - This project aims to **advance India's capabilities** in space exploration and bio-science research.
- **Focus on Health Impact Experiments:**
  - Some of the proposed experiments include:
    - Studying how **weightlessness affects muscle loss** in astronauts.
    - Exploring types of **algae** that could serve as **nutritional supplements** or **preserve food** for longer durations in space.

- Investigating how certain algae might be processed to produce **jet fuel**.
- Analyzing the **impact of radiation** on the health of individuals aboard space stations.
  - o **Potential Inclusion in Gaganyaan Mission:**
    - Before the BAS project, ISRO's major focus is the **Gaganyaan mission**, India's first **crewed mission to space**, slated for launch in **2025-2026**.
    - There will be **three uncrewed test missions** prior to the main Gaganyaan mission. Some of the proposed biotechnology experiments may be tested during these flights.
  - o **Bio-Manufacturing and the BIOE3 Policy:**
    - The ISRO-DBT partnership stems from the **BIOE3 (Biotechnology for Economy, Environment, and Employment)** policy initiated by DBT.
    - This policy aims to **boost bio-manufacturing** in India, with the bio-economy expected to reach a valuation of **$300 billion by 2030**.

Bharatiya Antariksh Station (BAS)

The **Bharatiya Antariksh Station (BAS)** will be **India's first indigenous space station**, scheduled for establishment in **2028**.

BAS is designed as a **national space-based facility** to support **advanced microgravity research** and **technology development**.

It aims to enhance India's **self-reliance** in space technology and provide a platform for **scientific experiments** in a controlled microgravity environment.

As part of this vision, the objective is to **launch an operational space station** by **2035** and pursue a **crewed lunar mission** by **2040**, extending India's capabilities in human space exploration.

BioE3 Policy (Biotechnology for Economy, Environment, and Employment)

The **BioE3 Policy** is initiated by the **Department of Biotechnology (DBT)** to foster **high-performance biomanufacturing**.

It focuses on the **integration of advanced biotechnological processes** to produce a range of products, from **medicines to materials**, addressing challenges in **farming and food** and promoting the manufacturing of **bio-based products**.

India's New Horizons in Space: Key Missions and Developments

Sub: Sci

Sec: Space tech

Why in News

India's space program has recently made significant strides, marked by **new project approvals, expanded missions, and the launch of international collaborations.** With the Union Cabinet's endorsement of multiple missions, including **lunar and Venusian explorations,** and the private sector's active involvement, **India is set to achieve critical milestones in space research and exploration.** These developments signal the country's rising ambitions in the space sector.

Recent Approvals and Financial Backing for New Missions:

Gaganyaan and Bharatiya Antariksh Station

The Union Cabinet approved four additional missions under the **'Gaganyaan' program, India's first human spaceflight project,** as well as four test missions for India's planned space station, **the Bharatiya Antariksh Station-1, set for 2028.**

Gaganyaan is a mission by the **Indian Space Research Organization (ISRO).**

Under the Gaganyaan schedule:

- Three flights will be sent into orbit.
- There will be two unmanned flights and one human spaceflight.

The Gaganyaan system module, called the **Orbital Module will have three Indian astronauts, including a woman.**

It will circle Earth at a **low-earth-orbit** at an altitude of 300-400 km from earth **for 5-7 days.**

Payloads:

- **Crew module** –spacecraft carrying human beings.
- **Service module** –powered by two liquid propellant engines.
- It will be equipped with **emergency escape and emergency mission abort**.

GSLV Mk III, also called the **LVM-3 (Launch Vehicle Mark-3,)** the three-stage heavy lift launch vehicle, will be used to launch Gaganyaan as it has the necessary payload capability.

Bharatiya Antariksh Station (BAS):

The BAS is expected to be operational between **2028 and 2035**, marking India's foray into establishing a permanent space station.

This project aims to **advance India's capabilities** in space exploration and bio-science research.

Development of Next-Generation Launch Vehicle (NGLV):

ISRO received clearance to develop a **Next-Generation Launch Vehicle (NGLV)** with an estimated budget of ₹8,240 crore, which covers the costs for the rocket's first three development flights.

ISRO's NGLV will be a **three-stage reusable heavy-lift vehicle**.

Pay load capacity will be **around 10 tonnes to Geostationary transfer orbit** (GTO) and twice the capacity to Low earth orbit (LEO).

NGLV will feature **semi-cryogenic propulsion** for the booster stages which is cheaper and efficient.

Potential applications will be in the areas of **deep space missions, launching communication satellites, future human missions and cargo missions.**

It allows bulk manufacturing and the turnaround time is minimal.

Till now, **PSLV and GSLV** are the major launch vehicles employed by the ISRO for satellite launches.

Commercialization of LVM-3 Rocket:

New Space India Ltd. (NSIL) is set to appoint a private entity to commercialize the **LVM-3 rocket,** marking another shift toward private participation in India's space sector.

The LVM-3 has 3 stages:

The first stage is in the form of 2 S200 boosters straps to the sides of the rocket body; combust **a solid fuel** called **hydroxyl-terminated polybutadiene**.

The second stage is powered by **Vikas Engines** (combust a liquid fuel) either **nitrogen tetroxide or unsymmetrical dimethylhydrazine.**

The final stage is Powered by a **cryogenic engine**. It combusts **liquified hydrogen with liquified oxygen.**

Chandrayaan-4:

Scheduled for **launch in 2027** with an estimated budget of ₹2,104 crore, Chandrayaan-4 will be a **sample-return mission,** aimed at bringing lunar soil and rock samples back to Earth.

LUPEX Collaboration:

A collaborative mission with Japan, **LUPEX will include a new ISRO-designed lunar lander** to be potentially used for future crewed lunar missions.

LUPEX is a collaborative mission between **ISRO and JAXA (Japan Aerospace Exploration Agency)** aimed at exploring the **lunar polar region.**

Goals: To study the **presence and distribution of water ice on the Moon's surface,** which is crucial for future lunar exploration and **potential human habitation.**

Mission Components: Includes an **ISRO-developed lander and a JAXA-built rover** equipped to operate in the extreme environment of the lunar poles.

Venus Orbiter Mission:

The **Venus Orbiter Mission,** set for launch in **March 2028** with a budget of ₹1,236 crore, aims to study Venus' surface and atmosphere, helping scientists understand the evolutionary paths of planets in the solar system.

Objective: To explore the **surface and sub-surface** of Venus, its **atmosphere** and its interaction with the Sun.

Optimal Launch Window: Earth and Venus align for the **shortest path every 19 months**. The mission is expected to be accomplished on the opportunity available during **March 2028.**

Payload: Scientific payloads include a high-resolution **Synthetic Aperture Radar, thermal cameras**

Trajectory: Similar to previous Indian space missions, the satellite will gain speed in Earth's orbit, will get **sling-shot towards Venus**, and then get captured in its orbit.

Travel Duration: Once launched, it will take about **140 days** to reach Venus after exiting Earth's orbit.

Space-Based Surveillance (SBS) Phase III:

The Cabinet Committee on Security approved **the third phase of SBS** on October 11, involving the **construction of 52 satellites, with ISRO producing 21 and private companies 31,** at a cost of ₹26,968 crore.

Objective: To strengthen **India's space surveillance capabilities,** enhancing security and monitoring in space.

Historical Context: Builds on earlier phases, **SBS-1 (2001) with 4 satellites and SBS-2 (2013) with 6 satellites.**

Significance: Improves tracking of space assets, debris monitoring, and defense readiness, aligning with India's growing focus on space security.

Axiom-4 Mission:

Axiom Mission 4 (or Ax-4) is a private spaceflight to the **International Space Station** which is operated by **Axiom Space** and uses a **SpaceX Crew Dragon spacecraft.**

Axiom-4 aims to facilitate commercial activities in space, including scientific research, technological development, and space tourism.

It is set to **carry a diverse crew of astronauts from different countries,** reflecting the growing international interest in space exploration.

Axiom-4 is expected to be a **short-duration mission, lasting approximately 14 days.**

Axiom Space's long-term vision includes building the **world's first commercial space station.**

NISAR Satellite:

A collaboration between **NASA and ISRO,** NISAR will be launched in **early 2025** using the **Geosynchronous Satellite Launch Vehicle.** Its radar antenna was modified for better heat resistance after testing in India.

Proba-3 Solar Observation Mission:

Europe's Proba-3, scheduled for launch on November 29 via **India's PSLV-XL,** will observe the **Sun's corona through dual satellite formation,** one blocking the Sun's core for detailed coronal study.

Objective: Proba-3 is a **European Space Agency (ESA) mission** focused on studying the Sun's corona to understand solar dynamics and space weather.

Technology: Utilizes two satellites flying in precise formation; one satellite blocks the Sun, creating an artificial eclipse, allowing the other to observe the corona.

Significance: Provides critical data on solar activity, which impacts satellite operations and Earth's electromagnetic environment.

India's Role: This collaboration reflects India's growing involvement in international space science initiatives, previously launching Proba-1 in 2001.

LEAP-3 Mission:

Manastu Space has partnered with **Dhruva Space** to test **green propulsion technology** for the **LEAP-3 mission** in 2025, marking a push for sustainable space exploration.

Green Propulsion Technology: Manastu's propulsion system, **powered by hydrogen peroxide,** represents a cleaner alternative for satellite missions.

Project 200 and Private Industry Milestones:

Project 200 by Bellatrix Aerospace: This **ultra-low earth orbit satellite prototype** aims to operate at 200 km altitude, adding to India's capabilities in the lower atmospheric layer.

China's Advancements in Space: New Crew Sent to Tiangong Space Station

Sub: Sci

Sec: Space sector

Why in News

China successfully launched a three-member crew to its **Tiangong Space Station** on Tuesday, marking a significant step in its competitive space program. As China continues to bolster its presence in space exploration, the mission reflects China's ambition to establish itself as a space power, paralleling the U.S. and other nations.

Launch Details:

The **Shenzhou-19 spaceship,** carrying two male and one female astronaut, launched from the **Jiuquan Satellite Launch Center in northwest China** on Tuesday. The mission relied on a **Long March-2F rocket,** the backbone of China's crewed space launches, and successfully docked with the **Tiangong Space Station** shortly afterward.

Shenzhou 19 is part of China's Shenzhou program, **initiated in 1992,** which supports its **national human spaceflight ambitions** and advances space exploration capabilities.

About Tiangong Space Station:

The Tiangong space station is a Chinese space station built in **low Earth orbit between 340 and 450 kilometres above the earth.**

It is part of **China Manned Space Program** and is the **country's first long-term space station.**

The three modules of the **Tiangong Space Station are**

- **The Tianhe** means **"Harmony of the Heavens"** is the **core module.**
- **Wentian** means **"Quest for the Heavens"** is a laboratory cabin module.
- **Mengtian** means "Dreaming of the Heavens" is a laboratory module.

With the fully functioning of the Space station China will become only the **third country in history to have put both astronauts into space and to build a space station**, after **Russia and the US.**

It is **one-fifth** the **mass** of the International Space Station

About Long March-2F rocket:

The Long March-2F rocket is **China's only crew-rated launch vehicle,** specifically designed to **carry astronauts to space.**

It was **first launched in 1999** and is part of the **Long March rocket family,** which supports **China's human spaceflight missions.**

The Long March-2F has a height of approximately **62 meters** and can carry a payload of up to **8.4 tons** to **Low Earth Orbit (LEO).**

It is powered by **four liquid-fuelled boosters** and two stages, using **nitrogen tetroxide and unsymmetrical dimethylhydrazine (UDMH) as propellants.**

Future Prospects and Global Space Competition:

As China moves forward with its **lunar and Mars missions,** the **U.S. remains a leading space power,** with **NASA planning its own lunar mission by 2026.** China's advancements underscore a growing global interest in space, pushing boundaries in exploration and international competition.