WEEKLY UPDATES

DATE : 28th Oct- 3rd Nov

POLITY & GOVERNANCE

U.S. Presidential Election System and Comparison with India's Presidential Election

Syllabus: Comparative Politics – Election Systems

Context: **In the United States, the President is elected through the** electoral college**, an indirect voting system where** electors appointed by each state **cast votes to determine the President. This unique approach highlights differences in democratic processes compared to countries like India, where the Presidential election is conducted by an Electoral College of** Members of Parliament (MPs) **and** Members of Legislative Assemblies (MLAs)**.**

U.S. Presidential Election Process

1. **Governing Articles**:
   o The **U.S. Constitution**, specifically **Article 2** and the **12th Amendment**, outline the election process for the President and Vice-President.
2. **Electoral College**:
   o **Structure**:
      ▪ Comprises **538 electors**, derived from **435 Representatives** and **100 Senators** in Congress, plus **three electors for the District of Columbia**.
   o **State Representation**:
      ▪ Each state's number of electors is equal to its **representation in Congress**.
      ▪ Example: **California** has the most electors (54), while smaller states like **Delaware** have the minimum of three.
3. **Voting Procedure**:
   o **Election Day Voting**: Citizens vote for their preferred candidate. The party that wins the popular vote in each state appoints its **slate of electors**.
   o **Electoral College Voting**: Electors meet in **December** to cast their votes, typically reflecting the state's popular vote.
   o **Winner-Takes-All Rule**: Most states follow a winner-takes-all approach, except for **Maine and Nebraska**, which use a **proportional allocation**.
4. **Faithless Electors**:
   o **Definition**: Electors who vote against their state's popular vote are termed **faithless electors**.

- o **Impact**: Though some states penalize them, faithless electors have had minimal impact on outcomes.
5. **Resolution of a Tie**:
    - o **Historical Precedent**: Ties occurred in **1800 and 1824**. In such cases, the **House of Representatives** votes to select the President, with each state delegation having one vote.
    - o **Tie Resolution**: A candidate needs **26 state votes** to win. If unresolved by the inauguration date, the **Vice-President** selected by the Senate assumes office temporarily.

Comparison of U.S. and Indian Presidential Election Systems

ASPECT	U.S. PRESIDENTIAL ELECTION	INDIAN PRESIDENTIAL ELECTION
ELECTORAL BODY	**Electoral College** with 538 electors	**Electoral College** of MPs and MLAs
CONSTITUTIONAL BASIS	**Article 2 and the 12th Amendment**	**Articles 52 to 71**
METHOD OF ELECTOR SELECTION	Electors chosen by **popular vote** in each state	**MPs and MLAs act as electors**; no public voting
VOTING SYSTEM	**Indirect**; state-by-state **winner-takes-all** for most states	**Single transferable vote** with proportional representation
ROLE OF FAITHLESS ELECTORS	Allowed in some states with limited impact	**Not applicable**
HANDLING OF TIES	**House of Representatives** chooses the President	**Re-election** by Electoral College if no candidate wins majority
ELECTION FREQUENCY	Every **4 years**	Every **5 years**
INAUGURATION DATE	**January 20** following election year	**Within a few days** after election results

Key Takeaways:

- **U.S. Presidential Election**: Indirect voting through an Electoral College with a winner-takes-all approach for most states.
- **Indian Presidential Election**: Conducted by MPs and MLAs through a single transferable vote system.
- **Distinct Approaches**: U.S. balances state representation, while India focuses on proportional representation through elected representatives.

Election Expenditure – A Comparative Analysis of India and the U.S.

*Syllabus: **Election Expenditure – Legal Framework, Challenges in Transparency, and Comparative Analysis of Election Spending Practices***

Context: In India, election spending **often exceeds the limits set by the** Election Commission of India (ECI)**, raising concerns around** influence-peddling and unequal representation**. Comparatively, countries like the** U.S. **prioritize transparency and limit donor influence to control election expenditure. This analysis explores** India's current laws**, compares them with the** U.S. model**, and suggests a way forward to improve** election financing fairness**.**

Current Laws Governing Election Expenditure in India

1. **Rule 90 of the Conduct of Election Rules, 1961**:
   - **Expenditure Limits**: Sets spending limits for candidates based on **election type and state size**.
   - **Current Limits**:
     - **Lok Sabha Elections**: ₹95 lakh for larger states, ₹75 lakh for smaller states/UTs.
     - **Legislative Assembly**: ₹40 lakh for larger states, ₹28 lakh for smaller states/UTs.
2. **Section 77 of the Representation of the People Act, 1951**:
   - **Mandatory Record-Keeping**: Requires candidates to **maintain a separate account** of all expenses incurred from **nomination to result declaration**.
3. **Expenditure Statement Submission**:
   - **Deadline**: Candidates must submit an **expenditure report** to the ECI within **30 days post-election**.
4. **Disqualification for Non-Compliance (Section 10A)**:
   - **Penalty**: Candidates who fail to comply with reporting requirements or exceed expenditure limits face **disqualification for three years**.
5. **Political Party Expenditure**:
   - **No Limit on Party Spending**: Political parties have no spending cap but are required to file expenditure reports to the ECI within **90 days after the election**.

Comparison of Election Expenditure in India vs. the United States

Aspect	India	United States
Expenditure Limits	Limits on candidate spending; no limit for political parties	Limits on contributions to candidates; no limit for Super PACs' independent spending
Funding Sources	Primarily **self-funding and donations**	**Individual contributions and PAC funding**, with Super PACs accepting unlimited funds
Spending Transparency	Limited transparency due to **self-reported spending**	High transparency with **disclosure requirements** by the Federal Election Commission (FEC)
Regulatory Body	**Election Commission of India (ECI)**	**Federal Election Commission (FEC)** and regulations governing **PACs and Super PACs**

Penalties for Violations	Disqualification for up to **three years**	Hefty fines, possible disqualification, though Super PACs face fewer restrictions on independent spending
Total Expenditure (2024)	Estimated ₹1,00,000 crore for Lok Sabha elections	Estimated **$16 billion (₹1,36,000 crore)** for U.S. presidential and Congressional elections

Key Issues in India's Election Financing Model

1. **Limited Transparency**:
   - **Self-Reported Spending**: Candidates and parties often report only a portion of actual expenditures, leaving significant spending unaccounted for.
2. **No Spending Limit for Parties**:
   - **Unrestricted Spending**: Political parties are free from expenditure limits, allowing them to spend excessively and creating an **uneven playing field**.
3. **Financial Assistance Loopholes**:
   - **Party-to-Candidate Funding**: Financial support given by parties to candidates is often not counted within spending limits, leading to **disguised expenditure**.
4. **Dependency on Private Donations**:
   - **Influence-Peddling**: The current system favors wealthier candidates, creating an environment where **financial influence overshadows public interest**.
5. **Lack of Judicial Capacity**:
   - **Delayed Dispute Resolution**: The limited capacity to address **election expenditure violations** delays accountability, reducing the effectiveness of expenditure limits.

Way Forward

1. **State Funding of Elections**:
   - **Partial State Funding**: Recommended by the **Indrajit Gupta Committee (1998)** and **Law Commission (1999)** to reduce reliance on **private donations**.
   - **Benefits**: Reduces **influence of wealthy donors** and provides a level playing field for candidates.
2. **Simultaneous Elections**:
   - **Cost Reduction**: Conducting Lok Sabha and State Assembly elections simultaneously could reduce costs and **streamline expenditures**.
   - **Challenges**: Requires **constitutional amendments** and logistical readiness for implementation.
3. **Cap on Party Expenditure**:
   - **Expenditure Limit for Parties**: Cap total party spending based on **candidate expenditure limits** multiplied by the number of candidates.
   - **Impact**: This can prevent **excessive spending** and promote fair competition.
4. **Amend Financial Assistance Laws**:
   - **Incorporate Party-to-Candidate Funding**: Ensure that any financial assistance provided by parties to candidates is **included in expenditure limits**.
   - **Objective**: Closes the loophole allowing disguised expenditure, ensuring **accurate financial reporting**.
5. **Enhanced Judicial Oversight**:

- o **Fast-Tracking Disputes**: Increase judicial capacity for swift resolution of **election disputes**.
- o **Deterrence**: A robust judicial mechanism could deter **violations of expenditure limits**, enforcing accountability.

Census Exercise and Its Implications on Delimitation and Legislative Reforms

Syllabus: Government Policies and Interventions, Electoral Reforms, Women's Reservation, and Constitutional Amendments

Context: **The Indian government has announced the commencement of the** delayed Census exercise **for 2024, expected to conclude by 2026. This Census is crucial, as it will impact two major processes:** delimitation of constituencies **and** reservation for women **in legislative bodies, leading to significant electoral and legislative changes.**

About the Census in India

1. **Frequency**:
   - o **Decennial Exercise**: Conducted every **10 years**, India's Census is a vital tool for **demographic data collection**.
2. **Historical Background**:
   - o **First City Census**: Conducted in **1830** in Dacca by **Henry Walter**.
   - o **First Non-Synchronous National Census**: Held in **1872** under **Lord Mayo**.
   - o **First Synchronous Census**: Conducted in **1881** under **W.C. Plowden**, establishing the **10-year cycle** followed to date.
3. **Global Comparison**:
   - o **Every 10 Years**: Countries like the **United States** and **United Kingdom** also conduct a census every 10 years.
   - o **Every 5 Years**: **Canada** and **Japan** conduct a census every five years.
4. **Responsible Authority**:
   - o **Office of the Registrar General and Census Commissioner** under the **Ministry of Home Affairs** manages India's Census.
5. **Legal Framework**:
   - o **Census Act of 1948**: Provides the legal framework for conducting the Census, introduced by **Sardar Vallabhbhai Patel**.
   - o **Union Subject**: The Census is listed as item 69 in the **Seventh Schedule** of the Constitution, making it a **Union subject** under **Article 246**.

Delimitation Exercise and Its Constitutional Basis

1. **Definition**: **Redrawing Constituency Boundaries**: Delimitation involves **adjusting electoral boundaries** to reflect population changes, managed by a **Delimitation Commission**.
2. **Historical Context**:

- o **Previous Censuses and Delimitation**: Since independence, seven censuses have been conducted, yet only four delimitations (1952, 1953, 1973, and 2002) have taken place.
- o **Last Delimitation**: The **2002 delimitation** adjusted boundaries without changing seat numbers, based on the **1971 Census** for Lok Sabha and the **2001 Census** for state Assemblies.

3. **Expected Changes with the 2026 Census**:
- o **Seat Adjustments**: Based on the projected population of **1.5 billion in 2026**, significant seat adjustments are anticipated, enabling **accurate representation** of population growth.

4. **Constitutional Provisions**:
- o **Article 82**: Mandates re-adjustment of seats in the **Lok Sabha** and state Assemblies after each Census.
- o **42nd and 84th Amendments**: These amendments in **1976** and **2001** froze delimitation until the **first Census post-2026**.
- o **Key Articles**: Articles **82, 81 (Lok Sabha composition), 170 (state Assemblies), and 55 (President's election)** need adjustments for aligning seat allocations with the latest population data.

Impact of Census and Delimitation on Women's Reservation

1. **Constitutional Mandate for Women's Reservation**:
- o **128th Constitutional Amendment**: Mandates a **33% reservation** for women in the Lok Sabha and state Assemblies.
- o **Implementation Timeline**: The women's reservation will be implemented only after **delimitation based on the first Census conducted post-2026**.

2. **Impact on Male Representation**:
- o **Reserved Seats**: In the 545-member Lok Sabha, **182 seats would be reserved for women**, affecting the **availability of seats for male representatives**.
- o **Seat Redistribution**: Delimitation will help reallocate seats, ensuring women's representation without reducing current representation levels.

3. **Challenges in Representation**:
- o **Population Imbalance**: Regions with varying population growth rates could face **imbalances in representation**, potentially affecting seat allocation between states.

Way Forward

1. **Constitutional Amendments**:
- o **Update Key Articles**: Articles **82, 81, 170, and 55** need updates to align with current demographic data for balanced representation in the **Lok Sabha** and state Assemblies.

2. **Balanced Delimitation Approach**:
- o **Criteria Beyond Population**: Delimitation should consider factors beyond population alone, including **regional growth**, socio-economic conditions, and infrastructure availability, to maintain equitable representation.

3. **Women's Reservation Implementation**:
- o **Smooth Reallocation Process**: Ensure that the reallocation of seats for the **33% reservation** for women is fair and transparent, facilitating a balanced legislative representation.

4. **Strengthen Regional Consensus**:
   - **Address North-South Population Divide**: Work towards balanced representation, especially between **northern and southern states** with differing population growth rates.
5. **Enhanced Stakeholder Engagement**:
   - **Political Support**: Engage **key political stakeholders** to build consensus for legislative amendments, ensuring smoother policy adoption and implementation.

Electronic Voting Machine (EVM): Features, Functionality, and Battery Concerns

Context: During the recent Haryana Assembly elections**, concerns were raised about** Electronic Voting Machine (EVM) **battery life discrepancies, with some EVMs showing** 99% battery **after polling. This raised questions about the device's battery behavior and reliability.**

About Electronic Voting Machine (EVM)

1. **Purpose**:
   - EVMs are **portable devices** designed for conducting elections for **Parliament, State Legislatures, and local bodies**, enabling **electronic voting** in place of traditional paper ballots.
2. **Key Features**:
   - **Voting Capacity**: Can record up to **2,000 votes**, making it suitable for high-voter turnout scenarios.
   - **Secure Storage**: Uses **encrypted memory** to ensure vote confidentiality.
   - **Backup Power**: Equipped with **non-rechargeable alkaline batteries**, allowing usage in areas without electricity.
   - **Multilingual Support**: Supports **multiple languages**, making it accessible to a diverse electorate.
   - **Audit Trail (VVPAT)**: Voter-verified paper audit trails (VVPAT) allow voters to verify their votes, adding a layer of transparency.
   - **Manufacturing**: EVMs are developed by **Bharat Electronics Limited (BEL)** and **Electronics Corporation of India Limited (ECIL)**, both Indian PSUs, under the guidance of the **Election Commission's Technical Experts Committee**.

About EVM Batteries

1. **Battery Type**:
   - **Non-rechargeable Alkaline Batteries**: Chosen for reliability and **five-year shelf life**.
   - **Voltage Display**: EVMs show **99% battery** even when voltage ranges from **8.2V to 7.4V**. The actual percentage indicator appears only when the voltage drops below 7.4V, which could explain why some machines showed 99% battery life after polling.
2. **Battery Choice and Rationale**:
   - **Stable Performance**: Alkaline batteries provide stable performance even in **extreme temperatures**.

o **Gradual Power Decline**: Alkaline batteries have a gradual power decline, allowing for predictable and uninterrupted EVM operation.

3. **Power Consumption**:
   o **Minimal Usage**: EVMs are designed to consume very low power and are not connected to any external network, unlike mobile phones, which results in **long-lasting battery life**.

Advantages of EVMs

1. **Efficiency in Voting**: EVMs streamline the voting process by allowing for quick vote recording and easy tabulation, reducing time and labor compared to paper ballots.
2. **Transparency with VVPAT**: The **Voter-Verified Paper Audit Trail (VVPAT)** ensures transparency by allowing voters to confirm their vote through a printed slip, which adds a level of trust in the system.
3. **Reliability**: **Durable Construction**: Designed for various environments, including remote and extreme settings, thanks to **battery backup** and **robust build quality**.
4. **Minimal Tampering Risk**: **Standalone Design**: EVMs are **not networked**, reducing the risk of hacking or tampering from external networks.

INTERNATIONAL RELATIONS

Refugee Camps in the Gaza Strip

Syllabus: International Relations – Refugee Crisis, United Nations Agencies, Middle Eastern Conflicts, and Humanitarian Issues

Context: The Gaza Strip has seen recent escalations in conflict, with Israeli military strikes **impacting various regions, leading to casualties, particularly in** northern Gaza**.** Palestinian refugee camps**, managed by the** United Nations Relief and Works Agency (UNRWA)**, play a critical role in providing essential services to the displaced populations in Gaza. However,** UNRWA does not govern **or police these camps, which are under the jurisdiction of local authorities.**

Key Refugee Camps in the Gaza Strip

1. **Beach Camp (Al-Shati Camp)**:
   o **Location**: Coastal area of Gaza.
   o **Characteristics**: One of the most **densely populated** camps in Gaza, with a severe **lack of space and resources**.
   o **Challenges**: Overcrowding and limited access to services make it vulnerable during conflicts.
2. **Bureij Camp**:
   o **Location**: Central Gaza.
   o **Size**: Relatively smaller in size compared to other camps.

- o **Impact of Conflict**: Heavily affected by military conflicts due to its central location and proximity to other camps.
3. **Deir El-Balah Camp**:
   - o **Location**: Near **Deir El-Balah city** in central Gaza.
   - o **Population**: Serves a large refugee population in the region.
   - o **Challenges**: Faces **infrastructure issues** and limited access to essential services.
4. **Jabalia Camp**:
   - o **Location**: Northern Gaza Strip.
   - o **Size**: The **largest refugee camp** in Gaza.
   - o **Challenges**: Severe **overcrowding** and **poor infrastructure**, leading to significant humanitarian concerns.
5. **Khan Younis Camp**:
   - o **Location**: Southern Gaza.
   - o **Characteristics**: Serves a mix of **urban and rural residents**, with a large refugee population.
   - o **Issues**: Economic hardships and high dependency on aid, especially during escalations in conflict.
6. **Maghazi Camp**:
   - o **Location**: Central Gaza.
   - o **Size**: Smaller in comparison to other camps.
   - o **Economic Impact**: Severely affected by **economic challenges** and **high unemployment rates** among residents.
7. **Nuseirat Camp**:
   - o **Location**: Near Bureij in central Gaza.
   - o **Population**: One of the more **densely populated camps** in central Gaza.
   - o **Conditions**: Faces **housing shortages** and infrastructure issues, exacerbated by economic hardship.
8. **Rafah Camp**:
   - o **Location**: Southern Gaza, near the **Gaza-Egypt border**.
   - o **Unique Challenges**: Heavily impacted by **border conflicts** and **restrictions**, making access to resources and movement highly restricted.

Role of UNRWA in Gaza's Refugee Camps

- **Essential Services**: Provides **healthcare, education, food assistance**, and other essential services to refugees.
- **Non-Governing Role**: **UNRWA does not govern or police** these camps; local authorities are responsible for security and administration.
- **Challenges in Operations**: Limited resources, high demand for services, and restricted access to some areas due to the ongoing conflict.

Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)

Syllabus: **International Relations – Global Security, Arms Control Treaties, and Non-Proliferation Organizations**

Context: The Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) **recently played a crucial role in** clarifying a false alarm **regarding suspected nuclear activity in Iran. This incident underscores the CTBTO's critical role in** global nuclear monitoring **and** preventing misinformation **related to nuclear tests, which supports** global security and stability**.**

About the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)

1. **Establishment**:
    - **Year**: The CTBTO was established in **1996** as the **interim Preparatory Commission** for the **Comprehensive Nuclear-Test-Ban Treaty (CTBT)**.
    - **Treaty Context**: The CTBT, which bans all nuclear explosions for military or civilian purposes, has not yet entered into force as several key nations have not ratified it.
2. **Headquarters**:
    - **Location**: The organization is headquartered in **Vienna, Austria**.
3. **Mission**:
    - **Primary Goal**: The CTBTO aims to prepare for the **CTBT's entry into force** by developing a **comprehensive verification regime** to monitor and detect nuclear tests worldwide.
    - **Global Promotion**: The CTBTO works to encourage **global adoption of the CTBT**, advocating for its universal ratification and implementation.
4. **Structure**:
    - **Preparatory Commission**: Consists of all **CTBTO Member States**, with **Working Groups** addressing administrative, financial, and verification issues.
    - **Provisional Technical Secretariat (PTS)**: Responsible for managing the CTBTO's verification mechanisms, including divisions for **International Monitoring**, **Data Management**, and **On-Site Inspections**.
5. **Funding**:
    - **Member-State Contributions**: Funded through contributions from member states, allowing the CTBTO to operate its extensive monitoring network.

CTBTO International Monitoring System (IMS)

1. **Network Size**:
    - **Global Monitoring Facilities**: The IMS consists of **337 monitoring facilities** across the globe, of which over **90% are operational**.
    - **Global Coverage**: Provides near-complete global coverage, allowing for **real-time detection of nuclear activities**.
2. **Monitoring Technologies**:
    - **Seismic Monitoring**:
        - **Purpose**: Detects **underground nuclear explosions** by analyzing ground shockwaves.
        - **Function**: Provides critical information on subterranean disturbances, helping distinguish between natural seismic activity and artificial nuclear tests.

- o **Hydroacoustic Monitoring**:
    - **Purpose**: Identifies **underwater nuclear explosions** through sound waves in oceans and seas.
    - **Function**: Essential for monitoring underwater nuclear tests, which produce distinct acoustic signals detectable over large distances.
- o **Infrasound Monitoring**:
    - **Purpose**: Monitors **low-frequency atmospheric sounds** generated by nuclear explosions.
    - **Function**: Detects explosions occurring in the atmosphere, capable of identifying low-frequency sounds that travel vast distances.
- o **Radionuclide Monitoring**:
    - **Purpose**: Detects **radioactive particles** released into the atmosphere during nuclear explosions.
    - **Function**: Confirms whether an explosion was nuclear by identifying specific radionuclides associated with nuclear reactions.

Significance of CTBTO's Verification Regime

1. **Global Security and Non-Proliferation**:
    - o **Deterrence Against Nuclear Testing**: The CTBTO's monitoring systems act as a **deterrent against unauthorized nuclear tests**, promoting a **nuclear-test-free world**.
    - o **Non-Proliferation Support**: Assists the **Non-Proliferation Treaty (NPT)** by monitoring and controlling the proliferation of nuclear weapons through test detection.
2. **Prevention of Misinformation**:
    - o **Quick Clarification**: CTBTO's systems can **verify or debunk suspected nuclear activities**, preventing **unnecessary escalation and panic** in global security.
    - o **Transparency**: Provides an independent verification source, contributing to **global trust** and **accountability** in nuclear non-proliferation.
3. **Scientific Advancements and Data Contribution**:
    - o **Seismology and Atmospheric Research**: The CTBTO's monitoring data also contributes to **scientific research** in fields such as seismology, oceanography, and atmospheric sciences.
    - o **Natural Disaster Monitoring**: IMS data has been useful for **earthquake and tsunami warning systems**, showcasing dual-use benefits.
4. **Strengthening International Cooperation**:
    - o **Multilateral Framework**: CTBTO offers a platform for countries to collaborate on **nuclear security and monitoring**, fostering **international cooperation**.
    - o **Encouragement for Ratification**: Encourages nations to ratify the CTBT, with a goal of achieving universal acceptance to enforce a comprehensive nuclear-test-ban.

Challenges Facing CTBTO

1. **Incomplete Ratification of the CTBT**:
    - o **Challenge**: The CTBT has yet to enter into force, as key nuclear-capable countries, including the **United States, China, India, Pakistan, and North Korea**, have not ratified it.

- o **Impact**: This limits the CTBTO's authority and full operational capacity, as the treaty remains in a preparatory phase.
2. **Funding and Resource Constraints**:
   - o **Challenge**: CTBTO relies on contributions from member states, making it vulnerable to **budget cuts** and **delayed contributions**.
   - o **Solution**: Encourage consistent and fair funding contributions from member states to sustain global monitoring capabilities.
3. **Technical Challenges in Verification**:
   - o **Challenge**: Differentiating between **nuclear explosions** and **natural events** like earthquakes can be complex.
   - o **Solution**: Continue advancing detection technology and **improving data analysis** to increase accuracy in verification.
4. **Geopolitical and Security Tensions**:
   - o **Challenge**: False alarms or unverified reports can lead to geopolitical tensions and **distrust among nations**.
   - o **Solution**: Maintain **transparent communication** and efficient verification to prevent escalation based on misinformation.

Iranian Military Bases in the News

Context: Recent satellite imagery **indicates damage at** two key Iranian military bases — Parchin **and** Khojir — **following a suspected** Israeli airstrike**. These bases are significant due to their links to** nuclear and ballistic missile programs**.**

Locations in News

1. **Parchin Military Base**:
   - o **Location**: Approximately **40 kilometers southeast of Tehran**, near the **Mamalu Dam**.
   - o **Significance**: Known for its historical association with **Iran's nuclear weapons program**. The **IAEA** has monitored it as a potential site for **explosive tests** that could be related to nuclear weapon development.
   - o **Damage**: Satellite images show that one building has been destroyed, with additional damage to other structures. The site includes **Taleghan 2**, a facility containing an **explosive testing chamber** and a **flash X-ray system**.
2. **Khojir Military Base**:
   - o **Location**: Around **20 kilometers from Tehran**, featuring extensive **underground facilities** and **tunnel systems**.
   - o **Significance**: Known for **missile production** and serves as a crucial component of Iran's **ballistic missile program**.
   - o **Damage**: The airstrike caused destruction at two structures within the base, impacting Iran's **missile manufacturing capabilities**.

BRICS and Venezuela's Bid for Membership

Context: Tensions have arisen between Venezuela and Brazil **after** Venezuela's bid to join BRICS **was reportedly blocked by Brazil, citing concerns over Venezuela's regional influence and internal stability. This incident sheds light on the criteria and geopolitical dynamics involved in BRICS membership.**

BRICS and the Joining Process

1. **Joining Process**:
   - **Candidate Evaluation**: BRICS evaluates potential members based on their **international influence, regional stability**, and ability to contribute to the bloc.
   - **Consensus Requirement**: All existing members must agree on the admission of a new member, with proposals typically considered during **annual BRICS summits**.
2. **Venezuela's Bid**:
   - **Application in 2024**: Venezuela sought to join BRICS to strengthen its international influence and economic ties with emerging economies.
   - **Rejection**: Brazil reportedly blocked the bid due to concerns over Venezuela's **regional standing** and **internal stability**, especially following a **contested presidential election**.

About BRICS

1. **Origin**: **Founded in 2009** to enhance cooperation among emerging economies and increase global influence as a counterbalance to Western-dominated institutions.
2. **Headquarters**: **No Permanent HQ**: BRICS does not have a centralized headquarters; its activities are coordinated through **annual summits hosted by member nations**.
3. **Current Members**:
   - **Core Members**: Brazil, Russia, India, China, South Africa.
   - **New Members in 2024**: Ethiopia, Iran, Egypt, and the United Arab Emirates.
4. **Key Features**:
   - **Economic Cooperation**: Promotes trade and investment within the group.
   - **Political Influence**: Acts as a counterforce to Western-dominated institutions like the IMF and World Bank.
   - **Multilateral Development**: Focuses on sustainable growth, infrastructure financing, and economic stability through initiatives such as the **New Development Bank**.

DEFENCE & SECURITY

India's Defence Sector and Export Expansion

Syllabus: Security and Strategic Studies – Defence Technology, Indigenous Defence Manufacturing, India's Defence Exports and Strategic Partnerships

Context: India's defence sector is witnessing a shift towards increased exports **and** indigenization, **driven by the** Aatmanirbhar Bharat initiative. **Recently, Armenia has emerged as a major buyer of** Indian-made weapon systems, **reflecting India's expanding footprint in the global arms market.**

Key Highlights of India's Defence Sector

1. **Top Export Markets**:
   - **Armenia, United States, and France** are significant importers of Indian defence equipment.
   - **Armenia's Purchases**: Includes **Akash air defence missiles**, **Pinaka rocket systems**, and **155mm artillery guns**.
2. **Export Record and Targets**:
   - **2023-24 Export Record**: India achieved a defence export value of **₹21,083 crore** ($2.6 billion).
   - **Future Targets**: India aims for **₹50,000 crore** in defence exports by 2028-29, establishing a robust **global defence market presence**.
3. **Strategic Collaborations**:
   - **BrahMos Missiles for the Philippines**: Strengthening India's presence in Southeast Asia.
   - **Brazil**: Interested in **co-production of advanced Akash missiles** to enhance its defence capabilities.
4. **Indigenous Production**:
   - **Domestic Production**: India achieved **₹1.2 lakh crore** in defence production in 2023-24.
   - **Future Goals**: Targeting **₹3 lakh crore** by 2028-29 under the **Aatmanirbhar Bharat initiative**.
5. **Industrial Base Expansion**:
   - **Public Sector Units (PSUs)**: Currently, 16 PSUs contribute significantly to defence production.
   - **Private Sector**: Over **430 licensed companies** and **16,000 MSMEs** are actively participating in defence manufacturing, indicating **threefold growth since 2014-15**.
6. **Global Standing**:
   - **Largest Arms Importer**: Despite growing exports, India remains the largest arms importer, accounting for **9.8% of global imports** (2019-2023).
   - **Vision for Self-Reliance**: Efforts are underway to reduce dependence on foreign arms by focusing on **indigenous production**.

Key Data Points (Important for Prelims and Mains)

Aspect	Details
Top Export Markets	**Armenia**, the U.S., and France are significant buyers; Armenia imports major systems like **Akash** and **Pinaka**.
Export Record	Reached **₹21,083 crore** in 2023-24; Target of **₹50,000 crore** by 2028-29.
Strategic Collaborations	Includes **BrahMos missiles** for the Philippines and potential co-production agreements with Brazil.
Indigenous Production	Achieved **₹1.2 lakh crore** in 2023-24; Aim for **₹3 lakh crore** by 2028-29.
Industrial Base Expansion	Includes **16 PSUs, 430 licensed companies, and 16,000 MSMEs** with threefold growth since 2014-15.
Global Standing	India is the **largest arms importer**, with **9.8% of global imports (2019-2023)**.

Way Forward

1. **Strengthen Indigenous Capabilities**: **Research and Development** in advanced technologies and **capacity-building** for domestic production to reduce reliance on imports.
2. **Increase Export Outreach**: Expand **marketing efforts** to reach new markets in **Africa, Southeast Asia, and Latin America**.
3. **Strategic Partnerships**: Collaborate with **global defence companies** for **technology transfer**, co-development, and joint production agreements.
4. **Support Private Sector Participation**: Provide incentives to **private players** and **MSMEs** involved in defence production, creating a more **competitive defence ecosystem**.
5. **Improved Policy Framework**: Further refine policies under the **Defence Procurement Procedure** and **Defence Production Policy** to simplify regulations and encourage **foreign investments**.

Fast Patrol Vessels (FPVs) of the Indian Coast Guard

Syllabus: *Indian Defence – Naval Security, Indigenous Manufacturing, Coastal and Maritime Security*

Context: The Indian Coast Guard (ICG) **recently launched two new** Fast Patrol Vessels (FPVs)**, named** 'Adamya' **and** 'Akshar'**, built by** Goa Shipyard Ltd. (GSL). **These vessels signify a commitment to** enhanced maritime security **and** indigenous defense manufacturing **under the** Aatmanirbhar Bharat **initiative. They are part of an eight-vessel contract worth** Rs. 473 crores**.**

About Fast Patrol Vessels (FPVs)

1. **Design and Dimensions**:
   - **Size**: FPVs measure **52 meters in length** and **8 meters in breadth**.
   - **Displacement**: With a displacement of **320 tons**, these vessels are light and agile, designed for high-speed operations and rapid response.
2. **Performance Capabilities**:

- o **Top Speed**: Equipped with a **Controllable Pitch Propeller (CPP)-based propulsion system**, FPVs can reach speeds of up to **27 knots**.
- o **Manoeuvrability**: The design and propulsion enable these vessels to **maneuver efficiently** in India's coastal and territorial waters.

3. **Indigenous Manufacturing**:
   - o **Self-Reliance in Defense**: Over **60% of components** in these FPVs are domestically sourced, contributing to **India's self-reliance in defense manufacturing**.
   - o **Built by Goa Shipyard Ltd. (GSL)**: GSL's involvement reinforces **local industry capabilities** and supports the "Make in India" initiative.

Primary Roles and Functions of FPVs

1. **Fisheries Protection**:
   - o **Monitoring Foreign Trawlers**: FPVs play a crucial role in **monitoring and preventing unauthorized fishing activities** by foreign vessels in Indian waters, helping safeguard the livelihoods of local fishermen and ensuring sustainable fishing practices.
2. **Coastal Patrol**:
   - o **Exclusive Economic Zone (EEZ) Surveillance**: FPVs conduct **regular patrols** along the Indian coastline and EEZ, ensuring **territorial integrity** and maritime security.
3. **Anti-Smuggling Operations**:
   - o **Preventing Illegal Trade**: FPVs actively prevent **smuggling activities** of narcotics, contraband, and other illegal goods in India's maritime boundaries.
4. **Search and Rescue (SAR)**:
   - o **Distress Response**: FPVs are equipped to conduct **search and rescue operations** for vessels or personnel in distress, ensuring quick response and **enhancing maritime safety**.
5. **Communication Link During Emergencies**:
   - o **Conflict and Emergency Support**: FPVs provide **essential communication channels** during conflicts, natural disasters, or other emergencies, maintaining **connectivity and coordination** in critical situations.
6. **Escort Services**:
   - o **Protecting Coastal Convoys**: During hostilities or wartime, FPVs serve as **escort vessels for convoys** moving along coastal routes, ensuring safe passage and **protection against potential threats**.

Significance of FPVs in India's Maritime Security

1. **Enhanced Coastal Security**:
   - o FPVs strengthen India's **maritime domain awareness** by maintaining a visible presence and conducting surveillance along the vast coastline, deterring potential threats.
2. **Support for Indigenous Manufacturing**:
   - o With over **60% indigenous components**, these FPVs support India's **defense manufacturing sector** and promote local industry involvement under **Aatmanirbhar Bharat**.
3. **Quick Response Capability**:

- o **High Speed and Agility**: With speeds up to 27 knots, FPVs enable rapid response to incidents along the coastline, ensuring **quick deployment** in emergencies or security threats.
4. **Versatile Roles**:
   - o The diverse operational roles of FPVs, from **anti-smuggling** to **search and rescue**, make them highly versatile assets that address both **security** and **humanitarian needs**.
5. **Boost to the "Make in India" Initiative**:
   - o The construction of FPVs by **Goa Shipyard Ltd.** aligns with India's **"Make in India"** initiative, enhancing the domestic shipbuilding industry and reducing dependency on foreign defense imports.

India's Joint Military Exercises: VAJRA PRAHAR and GARUD SHAKTI

Context: **India recently participated in two notable joint military exercises focused on enhancing cooperation and interoperability of** Special Forces**: Exercise VAJRA PRAHAR with the United States and** Exercise GARUD SHAKTI **with Indonesia. These exercises emphasize collaboration and training in different terrains and operational tactics, crucial for bolstering India's defense ties.**

1. Exercise VAJRA PRAHAR

- **Participants**: Indian Army Special Forces and the US Army's Green Berets.
- **Location**: **Orchard Combat Training Centre** in Idaho, USA.
- **Purpose**: Aims to enhance **cooperation, joint operations capability,** and **interoperability** between Indian and US Special Forces.
- **Training Focus**:
   - o Conducting joint missions in **desert and semi-desert conditions**.
   - o Tactics include **joint planning, reconnaissance missions**, utilization of **Unmanned Aerial Systems (UAS)**, and **psychological warfare**.

2. Exercise GARUD SHAKTI

- **Participants**: Indian **Parachute Regiment (Special Forces)** and Indonesia's **Special Forces, Kopassus**.
- **Location**: **Cijantung, Jakarta, Indonesia**.
- **Purpose**: Designed to strengthen **cooperation**, share **tactical knowledge**, and improve **interoperability** between the Indian and Indonesian Special Forces.
- **Training Focus**:
   - o Special operations in **jungle terrain**, conducting **strikes on terrorist camps**, and performing **tactical drills**.
   - o **Information sharing** on weapon systems, specialized techniques, and equipment.

Significance of Joint Military Exercises

1. **Strengthening Defense Ties**:

o These exercises reinforce India's strategic alliances with key partners like the US and Indonesia, facilitating defense cooperation beyond routine operations.

2. **Enhanced Tactical Knowledge**:
   o Training in varied terrains (desert, semi-desert, and jungle) allows forces to develop versatile tactical knowledge, preparing them for diverse combat environments.
3. **Boosting Interoperability**:
   o Joint exercises ensure that Indian Special Forces can operate seamlessly with allied forces, enhancing readiness for combined operations if required.
4. **Skill and Technology Sharing**:
   o Collaborative exercises provide an opportunity for **exchange of technology, operational techniques, and tactics**, improving the skills and capabilities of participating forces.

ECONOMY

Unpaid Labor and Its Economic Implications

Syllabus: ***Economics – Labor Economics, Gender and Economics, Policy Interventions***

Context: **A recent study,** *"Valuation of Unpaid Household Activities in India"* **by Sahoo, Sarkar, and Kumar, emphasizes the** economic significance of unpaid household work **in India, with a particular focus on the** disproportionate burden on women**. This analysis highlights the hidden contributions of unpaid labor to the economy and suggests the need for policy interventions.**

Unpaid Work and India's Status

1. **High Burden on Women**:
   o **Gender Disparity**: Indian women spend an average of **36 hours per week on unpaid domestic work**, compared to only **16 hours for men**.
   o **Impact on Employment**: Women outside the formal labor force spend over **seven hours daily on unpaid work**, which significantly restricts their ability to pursue paid employment.
2. **Economic Contribution**:
   o **National Impact**: Unpaid work contributes around **₹22.7 lakh crore** to India's economy, equivalent to **7.5% of GDP**.
   o **Missed Economic Value**: This contribution remains unaccounted for in official economic indicators, undervaluing national productivity.
3. **Labor Force Gap**:
   o The disproportionate unpaid workload limits **women's participation in the formal labor market**, leading to a **reduced labor force** and lower productivity levels in the paid economy.

Comparison with Global Trends

1. **Global Contribution**:

- **Range**: Worldwide, unpaid work contributes **10% to 60% of GDP**, varying significantly by region.
- **Examples**:
  - **APEC countries**: 9% of GDP.
  - **Australia**: Up to 41.3% of GDP.
  - **Thailand**: 5.5% of GDP.

2. **SDG Alignment**:
   - Recognizing unpaid labor aligns with **UN SDG 5** on gender equality, which advocates for **valuing unpaid care and domestic work** as a crucial aspect of gender equity.

Economic Valuation of Unpaid Work in India

1. **Monetary Estimation**:
   - **Gross Opportunity Cost (GOC) Method**: Values unpaid labor at **₹49.5 lakh crore** (24.6% of GDP) for 2019–20.
   - **Replacement Cost Method (RCM)**: Values unpaid work at **₹65.1 lakh crore** (32.4% of GDP) for the same period.

2. **Pandemic Impact**:
   - **Increased Burden**: During COVID-19, the value of unpaid work rose to **27.2% (GOC)** and **42.3% (RCM)** of GDP, reflecting a rise in household responsibilities as formal and informal support structures were strained.

Consequences of Unpaid Work

1. **Gender Inequality**:
   - **Financial and Professional Impact**: Disproportionate unpaid work perpetuates **gender inequality**, limiting women's financial independence and hindering professional advancement.

2. **Economic Underutilization**:
   - **Incomplete Economic View**: Excluding unpaid work from GDP provides a **skewed view of national productivity** and fails to recognize a significant portion of economic contributions.

3. **Reduced Workforce Participation**:
   - **Labor Market Impact**: High unpaid workloads restrict women's ability to engage in the formal labor market, lowering overall **labor force participation rates**.

4. **Health Impact**:
   - **Mental and Physical Strain**: The burden of unpaid work can lead to **stress, burnout**, and adverse health outcomes, particularly for those responsible for the majority of domestic duties.

5. **Policy Blind Spot**:
   - **Lack of Recognition**: Without quantifying unpaid work, it remains largely unaddressed in policy, perpetuating a significant social and economic issue.

Case Study: New Zealand's Wellbeing Budget

1. **Holistic Approach to Development**:

- o **Wellbeing Focus**: New Zealand's **2019 Wellbeing Budget** prioritizes citizen welfare alongside economic growth, targeting **mental health, child welfare, and gender equity**.
- o **Inclusion of Unpaid Labor**: By recognizing unpaid domestic labor, New Zealand's policy approach promotes **balanced social and economic development**.

2. **Relevance for India**:
    - o India can adopt a similar approach by **integrating unpaid labor** into policy frameworks to promote **holistic development**.

Way Forward

1. **Policy Recognition and Inclusion**:
    - o **National Indicators**: Develop frameworks to account for unpaid work in **GDP calculations** or create supplementary indicators that reflect its economic value.
2. **Redistribution of Domestic Labor**:
    - o **Promote Gender Equality**: Encourage the **shared responsibility of domestic tasks** through public awareness campaigns and educational initiatives to address gender disparities in unpaid work.
3. **Enhanced Data Collection**:
    - o **Frequent Time Use Surveys**: Conduct regular **Time Use Surveys** to gather accurate data on unpaid labor and support evidence-based policymaking.
4. **Supportive Services**:
    - o **Childcare and Eldercare**: Provide affordable **childcare, eldercare**, and other family support services to alleviate the unpaid workload, predominantly shouldered by women.
5. **Financial Support Mechanisms**:
    - o **Direct/Indirect Support**: Consider introducing **tax credits, subsidies, or social security benefits** for primary caregivers to recognize their contributions to unpaid labor.

India's Gold Reserves and Forex Reserves

Context: The Reserve Bank of India (RBI) **reports that** India's total gold reserves **amount to** 854.73 metric tonnes **as of September 2024. This reserve supports India's economic resilience and bolsters the country's forex reserves, which play a crucial role in stabilizing the economy.**

India's Gold Reserve Status

1. **Total Gold Reserves**:
    - o **Current Holdings**: India holds **854.73 metric tonnes** of gold.
    - o **Location**: Of this, **510.46 metric tonnes** are stored domestically by the RBI, while **324.01 metric tonnes** are held abroad, primarily with the **Bank of England** and the **Bank for International Settlements (BIS)**.
2. **Gold's Share in Forex Reserves**:
    - o **Share Increase**: Gold now constitutes **9.32% of India's forex reserves** as of September 2024, up from **8.15%** in March.
3. **Import Cover**:
    - o **Current Status**: As of June 2024, India's forex reserves provide an **import cover of 11.2 months**, slightly down from **11.3 months** in March.

4. **Global Ranking**:
   - **World Standing**: India ranks **8th globally** in terms of gold reserves.
   - **Top Countries**: The **United States** holds the largest gold reserves, with nearly as much gold as the combined reserves of the next three countries: **Germany, Italy, and France**.

About Forex Reserves

1. **Definition**:
   - **Composition**: Forex reserves consist of assets held by the RBI in **foreign currencies, gold, SDR (Special Drawing Rights)**, and **RTP (Reserve Tranche Position)** with the **IMF**.
2. **Purpose**:
   - **Currency Stability**: Forex reserves help stabilize the Indian rupee and provide a cushion against currency devaluation.
   - **Monetary Flexibility**: These reserves allow the RBI to manage exchange rates and support monetary policies effectively.
   - **Financial Security**: They serve as a safety net during economic instability, ensuring India's ability to meet international obligations.
3. **Importance**:
   - **International Confidence**: Strong forex reserves help India attract **foreign investment and trade**, enhancing its global reputation and economic resilience.

GEOGRAPHY

DANA (Cold Drop) – An Atmospheric Phenomenon

Context: The weather pattern known as DANA **(Depresión Aislada en Niveles Altos) or** "gota fría" **(cold drop) recently caused flash floods in** southern and eastern Spain, **resulting in widespread devastation and loss of life. This phenomenon, increasingly intense due to** climate change, **is affecting rainfall patterns in the** Mediterranean.

About DANA (Cold Drop)

1. **Definition**:
   - **DANA** stands for **"Depresión Aislada en Niveles Altos"** (isolated depression at high altitudes) and is also known as **gota fría** or cold drop in Spain.
2. **Formation**:
   - Occurs when a **pocket of cold air** descends over the warm Mediterranean Sea, leading to **atmospheric instability**.
3. **Mechanism**:
   - **Cold and Warm Air Interaction**: The cold air mixes with **warm, moist air**, causing it to rise quickly and form **cumulonimbus clouds** that bring heavy rainfall.
   - **Polar Jet Stream**: Involves the **polar jet stream** separating polar and tropical air; sometimes, a **cold air pocket detaches** and moves over the Mediterranean, sparking DANA.

4. **Seasonal Occurrence**:
   - Commonly observed in **autumn and spring** in the western Mediterranean.
5. **Intensity and Climate Change**:
   - Rising sea temperatures due to **climate change** intensify DANA events, as warmer air holds more moisture, leading to heavier rainfall and **more severe flash floods**.

AGRICULTURE

Paddy Variety PR-126 and Out Turn Ratio (OTR) Challenges

Syllabus: ***Indian Agriculture – Crop Varieties, Sustainable Agriculture, Agricultural Economics, and Crop Yield Management***

Context: **The** Indian government **is reviewing the widely cultivated** paddy variety PR-126 **in Punjab after complaints from local rice millers regarding** reduced rice yield **and concerns over the** Out Turn Ratio (OTR). **The issue highlights challenges in rice production and milling efficiency, impacting both** farmers and rice millers**.**

About Paddy Variety PR-126

1. **Introduction**:
   - **Large-Scale Adoption in Punjab**: PR-126 was introduced in **2016** and quickly adopted due to its **short growth duration** and **water efficiency**.
2. **Yield Concerns**:
   - **Reduced Out Turn Ratio (OTR)**: Rice millers report a **4-5% decrease in OTR** with PR-126, leading to less rice yield from each quintal of paddy (around **5 kg less rice per quintal**).
   - **Impact on Millers**: This reduction results in **financial losses** for millers, as they must meet the OTR standards set by the government.
3. **Intrinsic Defects**:
   - **Broken Grains**: Complaints include **broken grains** in the milled rice, which may stem from **early harvesting** or **hybrid seeds** being sold under the PR-126 name.
   - **Hybrid Variety Concerns**: Certain hybrid varieties similar to PR-126 may have been marketed as PR-126, potentially contributing to the yield and quality issues.
4. **Growth Duration**:
   - **Short-Duration Crop**: PR-126 is a **short-duration variety** maturing in **125 days** but can mature in as few as **110 days** under optimal conditions.
   - **Advantages**: Shorter growth periods allow for **efficient crop rotation** and reduce pressure on water resources.
5. **Water Efficiency**:
   - **Sustainable Agriculture**: PR-126 requires **less water**, aligning with sustainable agriculture practices in Punjab, a region facing **groundwater depletion**.
   - **Environmental Benefits**: Reduced water usage helps conserve resources, supporting long-term sustainability in agriculture.

About Out Turn Ratio (OTR)

1. **Definition**:
   - **Measurement of Yield Efficiency**: OTR, or **Out Turn Ratio**, measures the **percentage of rice yield**obtained from paddy after milling.
   - **Formula**: Calculated as the **weight of rice obtained per 100 kg of paddy** processed.
2. **Standard Requirement**:
   - **FCI Standards**: The **Food Corporation of India (FCI)** mandates an OTR of **67% per quintal**, meaning millers should produce **67 kg of rice per 100 kg of paddy**.
   - **Importance of Compliance**: This standard ensures consistency in yield and helps calculate fair market value for rice.
3. **Penalties for Shortfall**:
   - **Compensation to Government**: If millers fail to meet the 67% OTR standard, they must **compensate for the deficit**, incurring **financial losses**.
   - **Financial Impact**: Reduced OTR translates to approximately **₹300 per quintal** in added costs for millers, affecting profitability.
4. **Hybrid Variety Impact**:
   - **Lower OTR in Hybrids**: Certain hybrid varieties report OTRs as low as **60-62%**, well below the 67% threshold, leading to **substantial economic impact** on milling operations.
   - **Quality Concerns**: Low OTR may result from **quality issues in hybrid varieties**, such as grain breakage, which further reduces the quantity of marketable rice.

Challenges and Way Forward

1. **Ensuring Seed Quality and Authenticity**:
   - **Challenge**: Hybrid varieties sold as PR-126 may contribute to reduced yield and broken grains.
   - **Solution**: Implement **strict quality checks** on seeds to ensure that farmers receive **authentic PR-126 seeds**.
2. **Improving Milling Techniques**:
   - **Challenge**: Lower OTR may partially stem from the milling process itself.
   - **Solution**: Encourage **modern milling technologies** to minimize grain breakage and optimize yield, reducing losses due to quality issues.
3. **Conducting Research on Crop Quality**:
   - **Challenge**: Complaints about PR-126's yield highlight the need for crop-specific research.
   - **Solution**: **Increase R&D efforts** to identify factors contributing to low OTR, including possible improvements in crop management practices to enhance quality and yield.
4. **Training Farmers on Optimal Harvesting**:
   - **Challenge**: Early harvesting is believed to contribute to broken grains and reduced OTR.
   - **Solution**: Provide **farmer training programs** on **optimal harvesting times and techniques** to maintain crop quality.
5. **Promoting Sustainable Paddy Varieties**:
   - **Challenge**: High water usage and low yield efficiency in some varieties are unsustainable.
   - **Solution**: Encourage the development and use of **sustainable paddy varieties** that are water-efficient and yield high-quality rice, aligning with environmental goals.

India's Fertilizer Imports and Self-Sufficiency Efforts

Syllabus: *Indian Economy – Agriculture, Fertilizer Imports and Self-Reliance, Impact of Global Conflicts on India's Economy*

Context: **Amid escalating conflicts in** Ukraine **and** Gaza, **the global supply chain for fertilizers faces instability, intensifying concerns about** fertilizer availability and pricing. **India, with significant dependency on imported fertilizers, is exploring strategies to** enhance domestic production **and** reduce reliance on imports **to stabilize the agricultural sector.**

India's Fertilizer Import Dependency

1. **Current Dependence**:
   - **Urea**: Imports fulfill approximately **20%** of the total demand.
   - **Di-Ammonium Phosphate (DAP)**: India imports **50-60%** of its DAP requirements.
   - **Muriate of Potash (MOP)**: India is entirely dependent on imports for **100% of its MOP** needs.
2. **Primary Import Sources**:
   - Major import partners include **China, Russia, Saudi Arabia, UAE, Oman, Iran, and Egypt**.
   - **Geopolitical Conflicts** in Ukraine and Gaza have impacted supply chains and increased fertilizer prices.
3. **Fertilizer Import Challenges**:
   - **Supply Disruptions**: Conflicts directly affect **availability** and **costs**.
   - **Rising Costs**: Global **oil price surges** due to conflicts impact petroleum-based fertilizers, further escalating India's import costs.

India's Fertilizer Production Status

Category	Details
Total Production (2021-22)	**435.95 Lakh Metric Tonnes (LMT)** – covers part of the total demand of **579.67 LMT**.
Production by Type	- **Urea**: 250.72 LMT - **Di-Ammonium Phosphate (DAP)**: 42.22 LMT - **Nitrogen, Phosphorus, and Potassium (NPK)**: 89.67 LMT - **Single Superphosphate (SSP)**: 53.34 LMT - **Muriate of Potassium (MOP)**: Exclusively imported
Subsidy Allocation (2023-24)	**₹1.79 lakh crore** – Includes subsidies for indigenous and imported urea, as well as phosphorus and potassium fertilizers.

Challenges Facing India's Fertilizer Sector

1. **High Import Dependency**:
   - Significant dependency on imports for essential fertilizers, especially **MOP and DAP**, makes India vulnerable to **supply chain disruptions**.
2. **Limited Production Growth**:

- While production has grown from **385.39 LMT (2014-15)** to **435.95 LMT (2021-22)**, it remains **insufficient**to meet domestic demand, indicating the need for further expansion in production capacity.

3. **Fluctuating Global Prices**:
   - **Rising oil prices** from regional conflicts increase the cost of **petroleum-based fertilizers**, impacting both availability and affordability for Indian farmers.

4. **Environmental Concerns**:
   - Overuse of **chemical fertilizers** raises concerns about **soil health degradation** and long-term sustainability, necessitating a shift towards **eco-friendly alternatives**.

Recommendations and Way Forward

1. **Expand Domestic Production**:
   - **New Urea Plants**: Building new urea plants, similar to the six plants established post-2012, could significantly reduce dependency on imports.
   - **Boosting Capacity**: Focus on domestic production across various fertilizers to **enhance self-sufficiency**.

2. **Promote Alternative Solutions**:
   - **Nano-Urea and Bio-Fertilizers**: Support the adoption of **nano-urea** and **bio-fertilizers** to reduce reliance on conventional chemical fertilizers.
   - **Natural Farming**: Encourage **natural and organic farming practices** to promote sustainable agriculture.

3. **Invest in Research and Development**:
   - **Innovation in Fertilizers**: Increase investment in R&D for developing **alternative fertilizers** and **efficient farming techniques**.
   - **Efficiency Practices**: Research ways to improve fertilizer efficiency to reduce overall demand.

4. **Policy Reforms**:
   - **Encouraging Private and Cooperative Investments**: Reforms should create an environment that incentivizes **private sector and cooperative investments** in fertilizer manufacturing and distribution.

5. **Long-Term Sustainability Initiatives**:
   - **Soil Health Programs**: Implement **soil health management programs** to address degradation caused by excessive fertilizer use.
   - **Farmer Training**: Educate farmers on **efficient fertilizer use** and encourage practices that **preserve soil health**.

Transponder Technology and Its Role in Enhancing Fishermen's Safety

Syllabus: Science and Technology – Applications in Fisheries, Communication Systems, Satellite Technology, and Safety in Coastal Areas

Context: The Department of Fisheries**, under the** Pradhan Mantri Matsya Sampada Yojana (PMMSY)**, has implemented a** Vessel Communication and Support System **to improve the** safety and security of fishermen **at sea. This system leverages** indigenous transponder technology **developed by** ISRO **and implemented by** New Space India Ltd (NSIL)**, providing real-time two-way communication and crucial navigational support for fishermen venturing beyond mobile range.**

About the Vessel Communication and Support System

1. **Launch Date and Cost**:
   ○ **Initiated on**: August 30, 2024.
   ○ **Project Outlay**: ₹364 crore allocated for enhancing safety infrastructure in the fisheries sector.
2. **Objective**:
   ○ **Real-Time Communication**: Ensures **two-way communication** for fishermen operating in areas beyond mobile range, improving **safety** by enabling timely assistance and guidance.
   ○ **Emergency Response**: Allows for quick communication during **adverse weather conditions or emergencies**.
3. **Technology**:
   ○ **ISRO-Developed Transponders**: Utilizes **indigenous transponder technology** for precise vessel tracking, monitoring vessel speed, and emergency communication.
   ○ **Applications**: Provides **real-time updates** on sea conditions, weather alerts, and cyclone data, contributing to safer navigation.
4. **Nabhmitra Application**:
   ○ **Purpose**: Facilitates vessel tracking and offers **up-to-date information** on weather and sea conditions.
   ○ **Safety Alerts**: Sends real-time weather warnings and cyclone alerts, helping fishermen make informed decisions.
5. **Multilingual Support**:
   ○ **Language Accessibility**: Broadcasts in **local languages** to ensure non-English-speaking fishermen can access safety information, improving response times and enhancing safety.

About Transponders

1. **Definition**:
   ○ A **transponder** is a **wireless communication device** that **receives incoming signals**, amplifies them, and sends back a modified signal. It is essential for **vessel tracking** and communication in remote areas.
2. **Primary Functions**:

- o **Dual Role**: Acts as both a **transmitter and responder** (transmitter + responder).
- o **Signal Processing**: Shifts the **input signal frequency** and amplifies it for effective communication.

3. **Types of Transponders**:
   - o **Bent Pipe Transponder**:
     - ▪ **Function**: Converts the signal to **radio frequency**, boosts it, and transmits it back.
     - ▪ **Application**: Used in satellites as a **repeater** to facilitate communication over long distances.
   - o **Regenerative Transponder**:
     - ▪ **Function**: Processes the signal by **demodulating and remodulating** it, enhancing signal accuracy and clarity.
     - ▪ **Application**: Best suited for **digital signals**, providing high-quality data transmission.

4. **Comparison with Other Devices**:
   - o **Transponder vs. Transceiver**:
     - ▪ **Transponder**: Automatically responds to incoming signals with pre-programmed responses.
     - ▪ **Transceiver**: Can **send and receive signals** but does not have pre-set responses; it requires manual operation for sending responses.
   - o **Transponder vs. Transducer**:
     - ▪ **Transponder**: Handles **signal transmission and response**.
     - ▪ **Transducer**: Converts **one form of energy to another** (e.g., sound waves to electrical signals).

Significance of Transponder Technology in Fisheries

1. **Enhanced Safety and Security**:
   - o **Emergency Communication**: Transponders enable **two-way communication** for fishermen in isolated areas, ensuring they receive **assistance during emergencies** or adverse weather.
   - o **Real-Time Monitoring**: Allows authorities to **track vessel locations** and provide support during unexpected incidents.

2. **Reliable Navigation and Weather Alerts**:
   - o **Weather and Cyclone Alerts**: The system's real-time alerts provide critical **weather information**, helping fishermen avoid dangerous sea conditions.
   - o **Safer Navigation**: The **Nabhmitra application** aids in **safe navigation**, reducing risks associated with unpredictable maritime environments.

3. **Supports "Atmanirbhar Bharat"**:
   - o **Indigenous Development**: Developed by **ISRO** and implemented by **NSIL**, this technology reflects India's commitment to **self-reliance in advanced technology** and **maritime safety**.

4. **Improved Resource Management**:
   - o **Efficient Operations**: By allowing precise tracking and monitoring, transponder technology enables efficient management of fishing operations, promoting **sustainable fishing practices**.

Challenges in Implementing Transponder Technology

1. **Technical Limitations**:
   o **Range Limitations**: Transponders may face issues with **signal range**, especially in deep-sea fishing areas far from coastlines.
   o **Power Supply**: Continuous operation of transponders requires a stable **power supply**, which can be challenging on small fishing vessels.
2. **High Initial Costs**:
   o **Installation and Maintenance Costs**: Setting up and maintaining transponder systems can be costly, especially for small-scale fishing operators.
3. **Training and Awareness**:
   o **Skill Requirements**: Fishermen may require **training** to effectively use the communication devices and respond to alerts appropriately.
   o **Awareness of Benefits**: Ensuring fishermen understand the system's safety and operational benefits is crucial for widespread adoption.
4. **Multilingual Interface**:
   o **Language Support**: While the system offers multilingual support, ensuring **accurate translations and clear communication** in diverse regional languages can be a challenge.

Way Forward

1. **Extending Transponder Range**:
   o **Advanced Satellite Technology**: Collaborate with ISRO to develop **satellite-based solutions** that enhance transponder range, making them more effective in deep-sea operations.
2. **Subsidies and Financial Assistance**:
   o **Cost Reduction for Fishermen**: Provide **subsidies or financial support** to help fishermen afford transponder installations, particularly for small-scale operators.
3. **Comprehensive Training Programs**:
   o **Skill Development Initiatives**: Offer training on using transponders and related applications, including emergency response protocols and understanding alert systems.
4. **Continuous System Upgrades**:
   o **Technological Improvements**: Regularly update the system to improve **signal strength, durability, and accuracy** in tracking and weather updates.
5. **Strengthening Language Support**:
   o **Localized Language Options**: Work with linguists and regional experts to ensure that alerts and information are accurately conveyed in local languages, making the system more accessible.

ENVIRONMENT & ECOLOGY

Bandhavgarh Tiger Reserve

Context: Recently, four elephants were found dead**, with five others in poor health, in the** Bandhavgarh Tiger Reserve **in Madhya Pradesh. This incident raises concerns about wildlife management and the health conditions of animals in protected reserves.**

About Bandhavgarh Tiger Reserve

1. **Location**:
   o Situated between the **Vindhyan and Satpura ranges** in the **Umaria district** of **Madhya Pradesh**.
2. **Status**:
   o **National Park Status**: Declared a **national park in 1968**.
   o **Tiger Reserve Status**: Designated as a **Tiger Reserve in 1993** under **Project Tiger**.
3. **Topography**:
   o Known for its **valleys, hills, and plains**.
   o **Bandhavgarh Fort**: A historic fort within the reserve associated with **Lord Rama and Lakshmana** from the Ramayana, adding cultural significance to the reserve.
4. **Vegetation**:
   o **Forest Type**: Primarily tropical moist deciduous forests.
   o **Key Flora**:
      ▪ **Saj (Terminalia tomentosa), Dhaora (Anogeissus latifolia), Arjun (Terminalia arjuna),** and **Amla (Emblica officinalis)**.
   o **Bamboo**: Found on lower slopes, supporting the diverse habitat within the reserve.
5. **Fauna**:
   o **Tiger Population**: Known for its **Royal Bengal Tigers** and holds the **highest density of tiger population** in India and globally.
   o Other species include **leopards, deer,** and various birds, making it a rich habitat for biodiversity.

Durgesh Aranya Zoological Park and the Role of Indian Green Building Council (IGBC)

Context: The Durgesh Aranya Zoological Park **in** Kangra's Dehra constituency, **Himachal Pradesh, is set to become India's first** IGBC-certified zoo. **This certification reflects a commitment to** sustainable and eco-friendly infrastructure. **The project aims to not only protect biodiversity but also promote eco-tourism and sustainable development in the region.**

About Durgesh Aranya Zoological Park

1. **Location**:

- o Situated in the **Bankhandi area** of **Kangra's Dehra constituency**, Himachal Pradesh.
2. **Unique Attractions**:
    - o **Enclosures and Species**: The park will house **34 enclosures** within its **Van Vaibhav Path and Biodiversity Court**, featuring **73 species** including **Asiatic lions, crocodiles, gharials**, and indigenous bird species.
3. **Sustainability and IGBC Certification**:
    - o **Budget and Design**: Built with a budget of **₹619 crore**, the zoo emphasizes **eco-friendly and sustainable infrastructure**.
    - o **IGBC Certification**: It is India's first zoo certified by the **Indian Green Building Council (IGBC)**, underscoring its dedication to sustainable practices in construction and operation.
4. **Tourism and Employment Impact**:
    - o **Tourist Attraction**: Aims to attract visitors and support **eco-tourism** in Kangra.
    - o **Job Creation**: Expected to create employment opportunities and support Himachal Pradesh's economy by enhancing Kangra's status as the **"Tourism Capital"** of the state.

About the Indian Green Building Council (IGBC)

1. **Establishment and Headquarters**:
    - o **Founded**: Established in **2001** as part of the **Confederation of Indian Industry (CII)**.
    - o **Location**: Based in **Hyderabad, India**.
2. **Role and Services**:
    - o **Certification and Standards**: The IGBC is India's primary body for **green building certification**. It offers certifications and rating systems to promote sustainable and eco-friendly construction.
    - o **Training and Awareness**: Conducts training and awareness programs on **green construction practices**.
3. **Global Representation**:
    - o **World Green Building Council**: IGBC is one of the five countries represented on the **World Green Building Council board** and actively participates in global discussions on sustainability, such as the **COP events**.
4. **Rating Criteria**:
    - o **Assessment Categories**: Projects are rated based on criteria such as **energy efficiency, water conservation, hygiene, innovation, and sustainability**.
    - o **Recognition for Sustainable Practices**: This rating system motivates builders to adopt environmentally friendly practices and promotes a **greener approach to development**.

Significance and Impact

1. **Environmental Conservation**:
    - o **Eco-Friendly Infrastructure**: The IGBC certification of Durgesh Aranya Zoological Park signifies a commitment to **environmental conservation** by integrating green practices in zoo infrastructure.
2. **Promotion of Eco-Tourism**:
    - o **Tourism Development**: The park will serve as a **tourist attraction** while promoting eco-friendly practices, setting a precedent for other zoos and wildlife parks.
3. **Boost to Local Economy**:

- o **Employment Opportunities**: With job creation as a key goal, the zoo is expected to support the local economy and strengthen Kangra's tourism potential.
4. **Model for Future Projects**:
    - o **IGBC Influence**: As the first IGBC-certified zoo, Durgesh Aranya Zoological Park serves as a **model for sustainable development** in wildlife conservation areas, potentially influencing future projects across India.

Sambhar Lake and Recent Bird Deaths

Context: Sambhar Lake **in Rajasthan has seen the mysterious deaths of** 164 migratory birds**, raising fears of a** recurrence of avian botulism**. This bacterial disease previously caused the death of around** 18,000 birds in 2019 **at the lake.**

Why in News

- **Bird Deaths**: 164 migratory birds, including species like **Northern Shovelers** and **Black-winged Stilts**, were found dead.
- **Suspected Cause**: Preliminary investigations suggest **avian botulism**, a bacterial disease affecting birds in **low-oxygen environments**.
- **Response Actions**: Local authorities, with support from the **State Disaster Response Force (SDRF)**, are working to **remove dead birds** and prevent further spread, with multiple departments coordinating conservation efforts.

About Sambhar Lake

1. **Location**: Situated in **Nagaur and Jaipur districts**, Rajasthan, approximately **80 km southwest of Jaipur**.
2. **Largest Saltwater Lake**: **India's biggest inland saline lake**, covering an area of over **200 sq. km**.
3. **Shape and Water Sources**: **Elliptical shape**, fed by ephemeral streams such as **Mendha and Runpangarh**.
4. **Ramsar Site**: Designated as a **Ramsar site** in 1990, marking it as a wetland of **international importance**.
5. **Migratory Bird Habitat**: Important winter habitat for **flamingos, pelicans, and various migratory birds** during the colder months.
6. **Salt Production**: Produces approximately **210,000 tonnes of salt annually**, making Rajasthan one of India's leading salt-producing states.

1.5°C Goal and the Climate Crisis

*Syllabus***: Climate Change, Environmental Policies, and Global Governance**

Context: As world leaders prepare for the annual climate conference in Baku**, there is a renewed urgency to address** climate finance **and enforce stringent** emission reduction targets **to avoid severe repercussions from global warming. Meeting the** Paris Agreement's 1.5°C goal **requires coordinated international efforts, especially with current emissions trends pushing dangerously close to climate thresholds.**

Unabated Rise of Emissions

1. **Current Emissions**:
   - **2023 Levels**: Global emissions reached **57.1 billion tonnes of CO_2 equivalent**, a **1.3% increase** from 2022.
   - **Trend**: Emissions have risen almost every year, except in 2020 during the COVID-19 pandemic, when there was a brief dip due to reduced global activities.
2. **Necessary Target for 1.5°C**:
   - **Peak by 2025**: Emissions must reach their peak by **2025** and then steadily decline.
   - **Reduction by 2030**: To meet the 1.5°C goal, emissions need to be reduced by at least **43% from 2019 levels** by **2030**. However, current projections fall significantly short.

Why There is No Quick Relief from Warming

1. **Accumulated Greenhouse Gases**:
   - **Long Lifespan**: **CO_2** can persist in the atmosphere for hundreds of years, meaning that **historical emissions continue to drive warming**.
   - **Concentration Levels**: In 2023, CO_2 concentrations reached **420 ppm**, over **150% higher** than pre-industrial levels.
2. **Slow Impact of Reducing Emissions**:
   - **Gradual Warming Relief**: Even if emissions begin to decline, the cooling effect will be slow due to the **long atmospheric lifespan** of pollutants.
3. **Methane and Nitrous Oxide**:
   - Other gases like **methane** and **nitrous oxide** have also reached record levels, further contributing to the greenhouse effect and intensifying warming.

Missing the Targets

1. **Temperature Threshold Breach**:
   - **2023 Records**: Global temperatures were **1.45°C above pre-industrial levels**, the highest on record.
   - **WMO Projections**: Average global temperatures could breach the **1.5°C threshold** in the next few years if current trends persist.
2. **2030 Milestone**:

- o **IPCC Recommendations**: A **43% reduction in emissions by 2030** from 2019 levels is necessary. However, current projections suggest only a **2.6% reduction**, far below the required target.
3. **Decadal Average**:
   - o Between **2014-2023**, global temperatures averaged **1.2°C above pre-industrial levels**, pushing close to the **1.5°C threshold**.

Way Ahead

1. **Accelerated Clean Energy Transition**:
   - o **Renewable Shift**: Countries must expedite the transition to **renewable energy sources** like wind, solar, and hydro to reduce fossil fuel dependence.
2. **Climate Finance Agreement**:
   - o **Global Funding**: The Baku climate conference should finalize a global finance deal to support ambitious climate actions, especially for **developing countries** that lack resources.
3. **Enhanced Carbon Reduction Commitments**:
   - o **Updated Targets**: Nations must revise their **2030 emissions targets** with more stringent reductions to approach the **43% reduction goal**.
4. **Invest in Carbon Capture Technologies**:
   - o **Carbon Capture and Storage (CCS)**: Scaling up CCS technology can help remove excess **greenhouse gases** from the atmosphere.
5. **Focus on Methane Reductions**:
   - o **Immediate Impact**: Reducing non-CO_2 emissions, particularly **methane**, can have immediate benefits in slowing warming rates due to methane's shorter atmospheric lifespan.

Sanjay Dubri Tiger Reserve

1. **Location**: Situated in the **Sidhi district** of northeastern Madhya Pradesh, bordering **Guru Ghasidas National Park** to the south.
2. **Composition**: Comprises **Sanjay National Park** and **Dubri Sanctuary** with additional buffer zones from **Sidhi and Shahdol districts**.
3. **Ecological Corridor**: Part of the **Bandhavgarh-Sanjay-Guru Ghasidas-Palamau landscape**, this corridor forms a critical **wildlife movement route** between Bandhavgarh and Palamau Tiger Reserves, allowing for species migration and genetic exchange among tiger populations.
4. **Rivers**: Key rivers include **Banas, Gopad, Mawai, Mahan, Kodmar,** and **Umrari**, providing essential water sources for wildlife and supporting the reserve's ecosystem.
5. **Flora**: Dominated by **moist deciduous** and **dry deciduous sal forests**, with patches of **open sal forests** and bamboo remnants.
6. **Fauna**: Home to a variety of species, including **tigers, leopards, sloth bears, chital, nilgai, wild dogs, jungle cats,** and the **Indian python**.

Bandhavgarh Tiger Reserve

1. **Location**: Situated between the **Vindhyan and Satpura ranges** in the **Umaria district** of Madhya Pradesh.
2. **Status**: Declared a **national park in 1968** and gained **Tiger Reserve status in 1993** under **Project Tiger**.
3. **Topography**: Characterized by **valleys, hills, and plains** and is notable for the **historic Bandhavgarh Fort**, linked to **Lord Rama and Lakshmana** from the Ramayana.
4. **Vegetation**: Features **tropical moist deciduous forests**, including **sal, mixed forests,** and **grasslands**, with bamboo on the lower slopes.
5. **Flora**: Important species include **Saj (Terminalia tomentosa), Dhaora (Anogeissus latifolia), Arjun (Terminalia arjuna),** and **Amla (Emblica officinalis)**.
6. **Fauna**: Known for hosting the **Royal Bengal Tiger**, Bandhavgarh holds the **highest density of tigers** in India and globally, making it a crucial habitat for tiger conservation.

Conservation Concerns

1. **Impact of Infrastructure on Wildlife Corridors**:
   o **Habitat Fragmentation**: Resorts and conference halls can fragment the ecological corridor, impacting animal movement between tiger reserves.
   o **Disturbance to Wildlife**: Increased human presence and noise pollution can disturb wildlife, particularly sensitive species like tigers and leopards.
2. **Tiger Conservation and Corridor Importance**:
   o **Genetic Diversity**: Wildlife corridors allow tigers to move across landscapes, enabling **genetic exchange** that is vital for long-term survival.
   o **Conflict of Interest**: Balancing tourism and conservation remains challenging, as tourism-driven projects may disrupt tiger habitats.
3. **Tourism vs. Conservation**:
   o While tourism can generate revenue, unregulated development within protected areas and wildlife corridors can **threaten biodiversity**. A balanced approach is needed to protect core wildlife areas while supporting sustainable tourism in buffer zones.

BIOTECHNOLOGY & HEALTH

Tardigrades – Extraordinary Survivors and Applications in Extreme Environments

Syllabus: **Science and Technology – Biotechnology, Genetic Adaptation, Space Biology, and Applications in Extreme Environmental Studies**

Context: **Researchers have recently identified mechanisms behind the** remarkable radiation resistance **of a newly discovered species of tardigrades,** Hypsibius henanensis. **This discovery could have future applications in** space travel, nuclear cleanup, **and** cancer therapy, **given the tardigrades' ability to withstand extreme conditions.**

About Tardigrades

1. **Habitat**:
   o Tardigrades are **globally distributed** and thrive in diverse environments, including **terrestrial, marine, and freshwater ecosystems**.
   o They inhabit extreme locations from **polar regions** to **high-altitude mountains** and even **deep-sea habitats**.
2. **Extreme Survivors**:
   o Known for surviving under **extreme radiation**, temperatures ranging from **150°C to -272°C**, and enduring **decades without food or water**.
   o Tardigrades can survive **vacuum conditions of outer space** and extreme environmental stress by entering a state of **cryptobiosis**, where metabolic processes slow down to near dormancy.
3. **Unique Physiology**:
   o These microscopic, **eight-legged** creatures can **revive from a dried, lifeless state** after several years.
   o Their resilience has earned them nicknames like **"water bears"** and **"moss piglets"** due to their appearance and preference for moist environments.
4. **Size and Structure**:
   o Tardigrades are **microscopic but multicellular**, with a highly resilient body structure that enables them to endure harsh environments.
   o Their small size aids in **minimizing cellular damage** in extreme conditions.

Mechanisms of Radiation Resistance in Tardigrades (Hypsibius henanensis)

1. **Genetic Adaptation**:
   o **Genomic Composition**: Hypsibius henanensis has **14,701 genes**, with **30% unique to tardigrades**, indicating specialized adaptation.
   o **Gene Activation**: Certain genes activate in response to radiation exposure to **protect and repair DNA**, helping them resist otherwise lethal conditions.

2. **DNA Repair Mechanisms**:
   - **TRID1 Protein**: Uses a specialized protein called **TRID1** to repair **double-strand breaks in DNA** quickly, a critical response to radiation-induced damage.
   - **Efficient DNA Repair**: Their ability to repair DNA enables survival even under conditions where **radiation would typically destroy cellular structures**.
3. **Mitochondrial and DNA Repair Proteins**:
   - **Mitochondrial Protection**: Tardigrades produce specific proteins that maintain **mitochondrial function** under stress, ensuring that essential cellular energy production is unaffected by radiation.
   - **DNA Repair Support**: Produces proteins that **reinforce DNA repair mechanisms**, facilitating recovery after exposure to radiation.
4. **Antioxidant Pigments (Betalains)**:
   - **Betalain Production**: Tardigrades produce **betalain pigments** that act as antioxidants, neutralizing harmful chemicals and **reducing cellular damage** caused by radiation.
   - **Cellular Protection**: Betalains prevent the buildup of **reactive oxygen species** (ROS), molecules that damage cells when produced in response to radiation.

Applications of Tardigrade Research

1. **Space Travel**:
   - **Space Biology**: Tardigrades' radiation-resistant genes and mechanisms could help develop **protective measures** for astronauts against space radiation.
   - **Genetic Insights for Resilience**: Studying tardigrades could lead to **genetic modifications or treatments** that enhance resilience for long-duration space missions.
2. **Nuclear Cleanup**:
   - **Radiation Shielding**: Tardigrade-inspired technologies may be developed to protect **workers in radiation-exposed environments**.
   - **Protein Engineering**: By harnessing tardigrade proteins like TRID1, scientists could create **biotechnological tools** that aid in DNA repair in radioactive cleanup sites.
3. **Cancer Therapy**:
   - **DNA Repair Pathways**: Understanding tardigrades' DNA repair mechanisms may inform **cancer treatments** that focus on **cellular resilience and DNA repair**.
   - **Antioxidant Applications**: The betalain pigments could be studied for their **antioxidant properties**, which might protect healthy cells during **radiation-based cancer treatments**.

Global TB Report 2023 and India's Tuberculosis Challenge

Context: The Global TB Report 2023 **by the** World Health Organization (WHO) **provides a comprehensive look at global tuberculosis (TB) trends, revealing that TB remains the world's leading infectious killer, surpassing COVID-19.** India**, with the highest TB burden globally, has made strides in diagnosis and treatment but still faces challenges in meeting its** 2025 TB elimination target**.**

Key Findings of the Global TB Report 2023

1. **Global TB Cases**:
   - **8.2 million new cases** were reported worldwide in 2023.
   - **Leading Infectious Killer**: TB has overtaken COVID-19 as the **top infectious killer** globally.
2. **India's TB Burden**:
   - **Estimated Cases**: India recorded **2.8 million TB cases** in 2023, accounting for **26% of global cases**.
   - **TB Deaths**: India contributed to **29% of global TB deaths**, with an estimated **315,000 deaths** due to TB in 2023.
3. **Progress Towards 2025 Targets**:
   - **Case Reduction**: Since 2015, India has reduced TB cases by **18%**.
   - **Reduction in Deaths**: TB deaths have reduced by **24%** since 2015.
   - **Target Shortfall**: India aims for a **50% reduction in cases** and a **75% reduction in deaths** by 2025, highlighting the need for accelerated efforts.
4. **Increase in Diagnosed Cases**:
   - **Improved Diagnostic Reach:** Reported TB cases increased to **2.51 million** in 2023, with **85% of diagnosed patients** receiving treatment, reflecting improvements in diagnostic infrastructure.
5. **Multi-Drug-Resistant TB (MDR-TB)**:
   - **Global Burden**: India represents **27% of global MDR-TB cases**, indicating the urgent need for **targeted treatment strategies** and effective drug management.
6. **Funding Gap**:
   - **Funding Decline**: India's TB funding dropped from **$432.6 million in 2019 to $302.8 million in 2023**.
   - **Domestic Funding Reduction:** Domestic TB funding also fell, reaching **$253 million** in 2023, affecting India's capacity to address TB effectively.
7. **Catastrophic Health Costs**:
   - **Financial Burden:** For the first time, the report estimates that many households face **catastrophic health costs** due to TB, spending over **20% of their income on TB-related healthcare**.

Challenges and Recommendations

1. **High TB Burden and MDR-TB**:
   - **Challenge**: With **26% of global TB cases** and **27% of MDR-TB cases**, India faces a high burden requiring **specialized treatment** and increased awareness.

- o **Recommendation**: Implement **targeted drug-resistant TB strategies** to tackle MDR-TB, focusing on community-based healthcare and expanding TB screening.

2. **Funding Deficit**:
   - o **Challenge**: Reduced TB funding hampers India's progress towards its **2025 elimination target**.
   - o **Recommendation**: Increase government spending and secure **international funding** to bridge the financial gap, improving access to diagnostic and treatment facilities.

3. **Financial Burden on Households**:
   - o **Challenge**: Many households incur **catastrophic costs** due to TB, leading to financial strain.
   - o **Recommendation**: Introduce **financial support programs** for TB patients, such as subsidies and health insurance schemes, to alleviate the economic burden.

4. **Improving Diagnostic Coverage**:
   - o **Challenge**: Despite improvements, gaps in diagnosis still exist, especially in rural areas.
   - o **Recommendation**: Expand **diagnostic reach** by establishing TB centers in remote areas and using **mobile diagnostic units** for accessibility.

5. **Public Awareness and Stigma Reduction**:
   - o **Challenge**: TB is still stigmatized, leading to delayed diagnosis and treatment.
   - o **Recommendation**: Conduct **public awareness campaigns** to reduce stigma and encourage early diagnosis, involving community leaders and health workers.

6. **Strengthening Multi-Sectoral Collaboration**:
   - o **Challenge**: TB control requires collaboration across health, finance, and social sectors.
   - o **Recommendation**: Foster partnerships with **non-governmental organizations, community health organizations**, and **international bodies** for a multi-sectoral approach to TB control.

SCIENCE & TECHNOLOGY

India's Space Planning and Future Prospects

*Syllabus: **Science and Technology – Developments and their applications and effects in everyday life; Awareness in fields of Space Technology, and the Role of Space Agencies.***

Introduction: India's space program, driven by the Indian Space Research Organisation (ISRO)**, is poised for** major expansion **with ambitious missions, technological innovations, and strategic international collaborations. This** new phase of space exploration **reflects India's commitment to advancing space capabilities, achieving self-sufficiency, and increasing its global presence.**

Key Highlights of India's Space Program

1. **Gaganyaan Missions**:
   - o **Objective**: Developing **India's human spaceflight capability**.

- o **Scope**: Includes **four human spaceflight missions** and **one uncrewed flight**.
- o **Significance**: Marks India's entry into the league of **human spacefaring nations**.

2. **Bharatiya Antariksh Station (Space Station)**:
- o **Goal**: Launching India's first **space station** by **2028**.
- o **Preparations**: Involves **four test missions** aimed at ensuring mission readiness.
- o **Impact**: Positions India as a key player in **space habitation and research**.

3. **Next Generation Launch Vehicle (NGLV)**:
- o **Budget**: Allocated **₹8,240 crore**.
- o **Development**: In collaboration with the **private sector**.
- o **Capabilities**: Designed for **operational flights** and to support **heavy-lift capabilities**.

4. **Venus Orbiter Mission**:
- o **Timeline**: Planned for **2028**.
- o **Objective**: Studying **atmospheric** and **surface conditions** of Venus.
- o **Budget**: **₹1,236 crore**, aimed at advancing **planetary science**.

5. **Chandrayaan-4 (2027)**:
- o **Mission**: **Lunar sample-return** mission.
- o **Objective**: Collection of **lunar soil samples** for Earth-based analysis.
- o **Budget**: **₹2,104 crore**.
- o **Significance**: Enhances India's **lunar exploration capabilities**.

6. **LUPEX (Lunar Polar Exploration Mission)**:
- o **Partnership**: Collaborative mission with **Japan**.
- o **Objective**: Lunar exploration with a focus on **future crewed missions**.
- o **Significance**: Strengthens **international cooperation** in space exploration.

7. **Space-Based Surveillance (SBS-3)**:
- o **Network**: 52 satellites (21 by ISRO, 31 by private firms).
- o **Objective**: Advanced **space-based surveillance** capabilities.
- o **Budget**: **₹26,968 crore**, aimed at bolstering **national security** and **surveillance**.

8. **NISAR & Proba-3 Satellites**:
- o **NISAR**: Earth observation satellite, **launching by early 2025**.
- o **Proba-3**: Scheduled for **November 2024**, focusing on the **Sun's corona**.
- o **Impact**: Enhances capabilities in **Earth monitoring** and **solar research**.

9. **Private Sector Involvement**:
- o Companies like **Manastu Space** (green propulsion systems), **Bellatrix Aerospace** (low-orbit satellites), and **Ananth Technologies** (satellite assembly).
- o **Objective**: Aligns with global trends, enhancing **India's commercial space capabilities**.

Challenges in India's Space Planning

1. **Commercial Market Access**:
- o **Current Share**: India holds only **2.6% of the global space economy**.
- o **Implications**: Limits revenue generation from **satellite manufacturing** and **commercial ventures**.
- o **Need**: Increase share by expanding into high-value markets like **satellite services** and **launch platforms**.

2. **Technological Dependency**:

- Global Rank: India ranks **7th in satellite count** but is dependent on **imports** for high-tech components.
- Effect: Hinders **self-reliance** and increases costs for advanced missions.
- Solution: Focus on **indigenous technology development** for critical components.

3. **Policy and Legal Gaps**:
   - Current Situation: Lack of a **comprehensive space policy**.
   - Impact: Slows **regulatory progress** and commercial growth in the private sector.
   - Need: Develop a **structured space policy** that supports commercial and security objectives.

4. **Budget Constraints**:
   - Allocation: Space budget is **0.05% of India's GDP**, compared to **0.25%** in the **United States**.
   - Impact: Limits scope for **high-cost missions** and **advanced research**.
   - Recommendation: Increased budgetary allocation to support ambitious goals.

5. **Geopolitical Considerations**:
   - Global Tensions: Collaborative missions with international partners (e.g., **Artemis Accords**) require **diplomatic balancing**, particularly with **China**.
   - Solution: Engage in **strategic partnerships** that align with India's foreign policy while maintaining autonomy.

Way Forward

1. **Boost Private Sector Engagement**:
   - **Incentivize private companies** in satellite production, launch services, and space tech innovation.
   - Goal: Align with global trends, enhancing **commercial capabilities** and expanding **market access**.

2. **Strengthen Human Spaceflight Program**:
   - Investment: Allocate resources for **astronaut training** and **spaceflight infrastructure**.
   - Objective: Prepare for **crewed missions**, marking a milestone in India's **human space exploration**.

3. **Increase Budget Allocation**:
   - Move from **cost-effective** to **investment-intensive** missions to meet **ambitious goals**.
   - Focus: Adequate funding for complex missions and **international collaborations**.

4. **Develop Legal and Policy Framework**:
   - **Comprehensive Space Policy**: To support safe, structured, and sustainable space growth.
   - Benefits: Encourages **private investments**, ensures **commercial viability**, and enhances **security**.

5. **Expand International Partnerships**:
   - Strengthen ties with **global space agencies** for **joint missions** and **knowledge sharing**.
   - Goal: Promote peaceful, inclusive, and **mutually beneficial space exploration**.

Digital Arrest Scam – Understanding and Combating Cyber Threats

Syllabus: **Cyber Security, Role of Government in Cyber Safety, Legal Provisions for Cybercrime Prevention, Digital Literacy and Public Awareness Campaigns**

Introduction: The Digital Arrest Scam **has emerged as a significant cyber threat in India. Recently highlighted by** Prime Minister Narendra Modi **during his** Mann Ki Baat **address, this scam targets vulnerable individuals through impersonation and intimidation tactics. Cybercriminals pose as** law enforcement officials**, using fear and fake legal threats to coerce victims into revealing sensitive information.**

About the Digital Arrest Scam

1. **Definition**:
   - **Digital Arrest**: A type of cybercrime where **scammers impersonate officials** from Indian law enforcement agencies such as the **CBI, ED, or police**.
   - **Objective**: To create fear and manipulate victims into sharing **personal information** or **financial details**.
2. **Methodology**:
   - **Approach**: Scammers **call or video call victims**, often appearing in **official attire or background settings** to appear legitimate.
   - **Intimidation**: They claim the victim is involved in **serious crimes** like **money laundering** or **drug trafficking**, creating a sense of urgency and fear.
3. **Tactics Used**:
   - **Gathering Information**: Scammers **ask for personal data** under the guise of an investigation.
   - **Legal Threats**: They quote **fake legal provisions** and threaten **arrest** if the victim does not comply.
   - **Psychological Pressure**: By using intimidation and urgency, scammers exploit **psychological vulnerabilities** to coerce compliance.

Indian Laws Addressing Digital Arrest Scams

1. **Information Technology Act, 2000 – Section 66D**:
   - **Provision**: Deals with **cheating by impersonation** via electronic means.
   - **Penalty**: Includes **imprisonment** and fines, aimed at deterring impersonation-related cybercrimes.
2. **Indian Cyber Crime Coordination Centre (I4C)**:
   - **Role**: Established by the Ministry of Home Affairs to **coordinate and combat cybercrime** across the country.
   - **Actions**: I4C has been **blocking fraudulent accounts** used in scams, including over **1,000 Skype accounts** linked to digital arrest scams.
3. **Cyber Awareness Campaigns**:
   - **Cyberdost Platform**: A social media initiative by I4C, issuing **alerts and awareness** messages about digital scams.

- o **Educational Outreach**: Aimed at **preventing scams** by educating the public on **identifying fraudulent activities**.
4. **National Cyber Crime Reporting Portal**:
    - o **Reporting Mechanism**: Victims can report incidents on the **cybercrime.gov.in** portal or call the helpline number **1930**.
    - o **Significance**: Centralized platform for **filing complaints** and accessing **resources** on cyber threats.

PM Modi's Proposed Strategy to Combat Digital Scams

1. **Cyberhelpline**:
    - o **Helpline Number (1930)**: Encourages citizens to report scams directly through this national helpline, ensuring **quick access to support**.
2. **Cybercrime Reporting Portal**:
    - o **Digital Complaints Platform**: Citizens are urged to use **cybercrime.gov.in** to file complaints, creating an **official record** and expediting action.
3. **Public Awareness Initiatives**:
    - o **Educational Institution Involvement**: Prime Minister Modi has called for **educational institutions** to involve students in **awareness campaigns**.
    - o **Digital Literacy**: Educating citizens, especially young people, about **cyber threats** and **prevention measures**.
4. **Three-Step Safety Protocol**:
    - o **"Stop-Think-Take Action"**: A simple protocol advised by the PM to prevent hasty responses to suspicious calls. It emphasizes:
        - ▪ **Stop**: Pause and assess the situation.
        - ▪ **Think**: Consider the likelihood of the legitimacy of the call.
        - ▪ **Take Action**: Report suspicious calls to **official authorities**.

Electric Propulsion Satellite (Technology Demonstrator Satellite - TDS-1)

*Syllabus**: Science and Technology – Recent developments in satellite technology, Innovations in Space Technology, Role of ISRO in Technological Advancements*

Context: To reduce satellite weight **and** increase efficiency**, the** Indian Space Research Organisation (ISRO) **is set to launch its** first indigenous electric propulsion satellite, Technology Demonstrator Satellite (TDS-1)**, in December. This mission showcases a shift from** chemical propulsion **to** electric propulsion**, marking a critical technological advancement for India's space capabilities.**

About Electric Propulsion Satellite (TDS-1)

1. **Purpose**:
    - o **Demonstration of Electric Propulsion Technology**: Designed to steer satellites using **solar-powered ionized gas** rather than conventional chemical fuel.

- o **Goal**: To validate electric propulsion as a means to **reduce reliance on chemical fuels** and make satellite journeys to **geostationary orbit** more efficient.
2. **Benefits**:
   - o **Weight Reduction**: Significantly cuts down satellite mass; a **four-tonne satellite** can be reduced to **around two tonnes**.
   - o **Fuel Efficiency**: Requires much less fuel, as **ionized gases** provide a steady, long-term thrust, ideal for **geostationary transfers**.
3. **Technology**:
   - o **Use of Gases like Argon**: Gases such as **Argon** are ionized through **solar power** to generate propulsion.
   - o **Propulsion Mechanics**: Ionized gas particles are expelled from the spacecraft at high speeds, producing the **necessary thrust** to steer and maintain orbital positions.
4. **Historical Background**:
   - o **First Use in GSAT-9**: ISRO incorporated electric propulsion for the first time in **GSAT-9** (South Asia Satellite) in 2017, which used **imported Russian components**.
   - o **Current Advancement**: The TDS-1 will be the first fully **domestic electric propulsion system**, demonstrating **India's growing self-sufficiency in space technology**.
5. **Significance**:
   - o **Space Autonomy**: Reduces reliance on imported components and aligns with India's goal of **Aatmanirbhar Bharat (Self-Reliant India)** in space technology.
   - o **Cost Efficiency**: Lower fuel requirements reduce launch costs and make more room for **payloads**.
   - o **Sustainability**: Electric propulsion reduces the **environmental footprint** by eliminating the need for toxic chemical fuels.

Way Forward

1. **Further Advancements in Electric Propulsion**:
   - o ISRO could explore **higher power electric thrusters** for **deep-space missions** and **long-duration** satellite operations.
2. **Enhanced Payload Capacity**:
   - o With reduced mass, **future satellites** can carry **more advanced payloads** for applications in communication, Earth observation, and interplanetary exploration.
3. **Private Sector Involvement**:
   - o Increased collaboration with **private space companies** for component manufacturing and **technology co-development** to boost capacity.
4. **Global Collaboration**:
   - o Potential for **international partnerships** to develop electric propulsion systems for **interplanetary missions**, with India providing **technology expertise**.

Luminescent Nanomaterials: A New Tool Against Counterfeiting

Context: **To address the growing issue of** counterfeiting, **scientists at the** Institute of Nano Science and Technology (INST) **have developed a** security ink **based on** luminescent nanomaterials. **This innovation provides an advanced solution for verifying the authenticity of items such as** currency, certificates, branded products, and medicines.

About Luminescent Nanomaterials

1. **Unique Properties**:
   - **Rare Earth Ions**: Luminescent nanomaterials are **doped with rare earth ions** that allow them to exhibit unique luminescent properties.
   - **Color Variance with Wavelength**: The color of luminescence changes based on the wavelength of light exposure, offering a **multi-wavelength security feature**.
2. **Multi-Color Display**:
   - **Blue under 365 nm UV Light**: The ink displays a vibrant blue color.
   - **Pink under 395 nm UV Light**: Changes to pink under a different UV wavelength.
   - **Orange-Red under 980 nm Near-Infrared Light**: Appears orange-red under near-infrared light, adding another layer of security.
   - **Enhanced Security**: The color variations make it difficult for counterfeiters to replicate and offer **multiple layers of authentication**.
3. **Durability**:
   - **Environmental Resistance**: The ink remains effective across a wide range of **light, temperature, and humidity** conditions, making it suitable for long-term applications and ensuring the integrity of security markings.

Applications in Counterfeit Prevention

1. **Advanced Security Feature**:
   - **Improved Covert Tagging**: Traditional covert tags that are visible only under UV light are relatively easy to replicate. This multi-wavelength, color-changing ink offers a **higher level of security**, making it more challenging to duplicate.
2. **Versatile Use**:
   - **Currency and Certificates**: Ensures the authenticity of **banknotes** and **official certificates**.
   - **Branded Goods**: Can be applied to **high-value branded items** to prevent counterfeiting and protect brand integrity.
   - **Medicines**: Useful in the pharmaceutical industry to verify the authenticity of **medicines**, thereby reducing the risk of counterfeit drugs in the market.
3. **Ease of Verification**:
   - **Consumer and Manufacturer-Friendly**: This luminescent ink allows easy verification using specific wavelengths, making it a **practical and accessible tool** for both consumers and manufacturers to confirm authenticity.

Advantages Over Traditional Security Features

- **Multi-Wavelength Authentication**: Unlike traditional UV-based covert tags, this ink provides security across multiple wavelengths, adding complexity and making duplication more difficult.
- **Durability**: With its resilience to environmental factors, this ink can be applied to items requiring long-term authenticity verification without degradation.
- **Adaptability**: The ink's ability to be used on a wide range of products, from documents to pharmaceuticals, makes it versatile in combating counterfeiting across industries.

LiDAR Technology and Its Applications

Context: **Using** LiDAR (Light Detection and Ranging), **scientists recently detected a** lost Mayan city **hidden beneath the dense Mexican jungle, showcasing the technology's capabilities in** archaeology **and remote sensing. LiDAR enables the discovery of features obscured by vegetation, revolutionizing how we map and explore the Earth's surface.**

About LiDAR (Light Detection and Ranging)

1. **Definition**:
   - **LiDAR** is a **remote sensing technology** that uses **pulsed laser light** to measure distances. This allows scientists to create **3D models** of the Earth's surface with high precision.
2. **Components**:
   - **Laser**: Emits pulsed light to map terrain.
   - **Scanner**: Captures the reflected light to gather data.
   - **GPS Receiver**: Ensures accurate location tracking.
   - **Mounting**: Often mounted on **aircraft** for terrain mapping, enabling extensive coverage over challenging landscapes.
3. **Functioning**:
   - **Laser Pulses**: The laser pulses travel from the LiDAR system to the ground, where they reflect off objects like trees, structures, and the ground surface.
   - **Distance Measurement**: By calculating the **two-way travel time** of the light, the system measures distances and generates elevation data.
4. **Data Output**:
   - **Point Cloud**: Initially produces a **point cloud**, representing the reflections from structures, vegetation, and terrain features.
   - **Digital Elevation Models**: Refined to form **high-resolution Digital Elevation Models (DEMs)** for detailed topographical mapping.

Applications of LiDAR

1. **Geography and Terrain Mapping**:
   - **Land Mapping**: Useful for creating accurate topographical maps, especially in areas difficult to access on foot.
   - **Urban Planning**: Assists in designing infrastructure and planning cities by providing detailed land surveys.
2. **Conservation and Environmental Management**:

- o **Forest Density and Vegetation Analysis**: Helps in studying forest canopies, calculating biomass, and assessing deforestation.
- o **Flood Modeling**: Creates high-resolution terrain models for flood-risk assessment and management.

3. **Policy and Infrastructure Planning**:
    - o **Transportation**: Used in planning roads, railways, and highways by mapping the terrain and identifying potential obstacles.
    - o **Utilities and Power Lines**: Assists in monitoring vegetation encroachment around power lines, preventing outages and ensuring safety.

4. **Archaeology**:
    - o **Hidden Structures Detection**: LiDAR has revolutionized archaeology by revealing structures hidden under dense foliage. For example, LiDAR enabled the discovery of the **Maya city of Valeriana** in Mexico.
    - o **Large Area Survey**: Allows archaeologists to survey vast regions quickly, saving time and resources and providing insights into ancient civilizations without extensive ground excavation.

Case Study: Discovery of the Lost Mayan City

1. **Location**: The **Maya city of Valeriana** was discovered in Mexico using LiDAR, hidden beneath the dense jungle.
2. **Benefits in Archaeology**: LiDAR enabled scientists to **penetrate the forest canopy** and reveal ancient structures that were previously inaccessible or unknown.
3. **Impact on Research**: This discovery adds valuable information about ancient Maya civilization, illustrating the importance of advanced technology in uncovering historical data.

Black Hole Triple System: A Rare Discovery

Syllabus: *Science and Technology – Astronomy, Space Exploration*

Context: **Scientists have identified a rare** "black hole triple" system **located approximately** 8,000 light years away **in the** constellation Cygnus. **This unique configuration consists of a** black hole and two companion stars**, offering new insights into black hole formation and challenging traditional theories.**

About the Black Hole Triple System

1. **Definition**:
    - o A **black hole triple system** consists of a **black hole** with two companion stars. In this system, one star orbits the black hole closely, while a second, more distant star orbits the entire configuration at a far greater distance.
2. **Discovery**:
    - o **Black Hole**: Named **V404 Cygni**, this black hole is around **nine times the mass of the Sun**.
    - o **Location**: Situated in the **constellation Cygnus**.

- o **Observation**: Discovered by researchers examining an astronomical repository, they identified the triple system through gravitational interactions between the two stars, confirming its unique configuration.
3. **Orbital Configuration**:
  - o **Close Companion**: One star closely orbits the black hole, where it is actively being consumed by the black hole's gravitational pull.
  - o **Distant Star**: The second star orbits the black hole at a distance, completing an orbit approximately **every 70,000 years**.

Significance of the Discovery

1. **Challenges Traditional Theories**:
   - o **Conventional Formation**: Traditionally, black holes are thought to form through **supernova explosions** that often eject nearby stars due to the violent release of energy.
   - o **Triple System Rarity**: The presence of two stars orbiting the black hole defies this understanding, as nearby stars would likely be expelled in a typical supernova event.
2. **Direct Collapse Formation**:
   - o **Failed Supernova**: V404 Cygni is believed to have formed via a **"direct collapse" or "failed supernova** "process, where a massive star collapses directly into a black hole without a powerful explosion.
   - o **Gentle Formation**: This less explosive formation process allows the black hole to **retain nearby stars**, which would have otherwise been pushed away in a supernova event.
3. **Implications for Binary Systems**:
   - o **Binary Black Holes as Former Triples**: This discovery implies that some known **binary black hole systems** may have originally been **triple systems**, where the black hole consumed one of its companion stars.
   - o **Astrophysical Models**: Understanding this formation mechanism could prompt revisions in models of black hole formation, especially in **binary and triple star systems**.

Scientific and Astrophysical Implications

1. **Insights into Black Hole Formation**:
   - o **New Formation Pathways**: This discovery highlights alternative pathways for black hole formation and may provide insights into why some black holes retain nearby stars while others do not.
2. **Gravitational Dynamics**:
   - o **Complex Interactions**: The gravitational interactions in a triple system are complex, especially when a black hole is involved. Studying these dynamics could deepen our understanding of **orbital mechanics** in multi-body systems with extreme gravitational fields.
3. **Future Research**:
   - o **Observational Studies**: This discovery could lead to focused research on similar systems, helping astronomers determine the frequency and nature of **black hole triples** in the universe.

o **Modeling Failed Supernovae**: Understanding direct collapse scenarios will aid in refining astrophysical models that currently emphasize explosive supernovae as the primary formation method for black holes.

SCHEMES AND INITIATIVES IN NEWS

Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY)

*Syllabus: **Government Policies and Interventions in Health, Social Welfare Schemes, Healthcare Accessibility***

Context: On the occasion of Dhanvantari Jayanti **(9th Ayurveda Day), the Prime Minister is set to announce the** expansion of AB PM-JAY **to provide health coverage to all** senior citizens aged 70 and above**. This enhancement aims to cover senior citizens** irrespective of income**, furthering the scheme's commitment to** universal health access **for the elderly.**

About Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY)

1. **Launch Year**:
   o **2018**: AB PM-JAY was launched as a **flagship healthcare scheme** under the **Ayushman Bharat** program, with a focus on providing **accessible and affordable healthcare** to India's vulnerable populations.
2. **Objective**:
   o **Health Insurance Coverage**: Offers up to **₹5 lakh per family per year** for **secondary and tertiary care** hospitalizations.
   o **Financial Protection**: Aims to reduce **out-of-pocket healthcare expenses** for economically weaker sections, covering a broad range of **medical treatments and procedures**.
3. **Coverage**:
   o **Target Population**: Currently provides coverage to approximately **55 crore individuals** across **12.34 crore families** nationwide.
   o **Inclusivity**: Focuses on marginalized and vulnerable families, ensuring that essential healthcare is accessible to those most in need.
4. **Recent Expansion to Senior Citizens**:
   o **Senior Citizens (70+)**: The recent expansion will provide coverage for **all citizens aged 70 years and above**, regardless of their income level.
   o **Impact**: This expansion aims to ensure **financial security** and **accessible healthcare** for the elderly population, addressing healthcare inequalities for senior citizens.

Key Features of AB PM-JAY

1. **Universal Health Access**:
   - o **Inclusivity in Healthcare**: Ensures that no citizen, especially the marginalized and economically vulnerable, is deprived of **essential healthcare services**.
2. **Health and Wellness Centres (HWCs)**:
   - o **Primary Healthcare Infrastructure**: Aims to establish **1,50,000 Health and Wellness Centres (HWCs)**across the country.
   - o **Preventive and Curative Care**: These centers emphasize **preventive, promotive, and curative health services**, including **screening for diseases, vaccinations,** and **awareness programs**.
3. **Expanded Coverage for the Elderly**:
   - o **Universal Coverage for 70+ Citizens**: Expands the scheme to cover all citizens aged 70 and above, regardless of their income, enabling **comprehensive healthcare** for the elderly.
   - o **Financial Security**: Protects senior citizens from the high costs associated with healthcare, especially during critical ailments.
4. **Financial Protection for Vulnerable Populations**:
   - o **Reduction in Out-of-Pocket Expenditure**: Covers a wide array of **medical treatments and procedures**, reducing the burden on low-income families.
   - o **Comprehensive Care**: Covers costs for **hospitalization, surgeries, diagnostics,** and **medications** at both **secondary and tertiary care levels**.

Benefits of AB PM-JAY

1. **Accessibility for the Marginalized**:
   - o **Health Equality**: Provides health coverage to underprivileged families and senior citizens, ensuring that healthcare is **inclusive and equitable**.
2. **Enhanced Primary Healthcare Infrastructure**:
   - o **Health and Wellness Centres (HWCs)**: These centers offer a foundation for **accessible primary healthcare**, reducing the demand for hospital-based services and **promoting preventive health**.
3. **Reduction of Financial Burden**:
   - o **Insurance Coverage**: By covering a wide range of treatments, AB PM-JAY significantly reduces **out-of-pocket healthcare costs**, which are often a major financial burden for low-income families.
4. **Encouragement of Preventive Health**:
   - o **Focus on Preventive Services**: HWCs under AB PM-JAY provide **preventive care** to reduce disease incidence and improve community health outcomes.
5. **Support for Senior Citizens**:
   - o **Expansion for the Elderly**: The new coverage for senior citizens (70+) without income restrictions ensures that the elderly have access to **timely healthcare** without financial stress.

Challenges and Way Forward

1. **Awareness and Accessibility**:

- o **Challenge**: Many eligible beneficiaries are unaware of the scheme or face **difficulties accessing facilities**.
- o **Way Forward**: Conduct **awareness campaigns** at the grassroots level and improve **accessibility** in remote areas.

2. **Quality of Care**:
- o **Challenge**: Ensuring quality healthcare services in both public and empanelled private hospitals.
- o **Way Forward**: **Stringent quality checks** and **standardized treatment protocols** to maintain quality standards in all healthcare facilities.

3. **Infrastructure and Human Resources**:
- o **Challenge**: Insufficient infrastructure and healthcare professionals, especially in **rural areas**.
- o **Way Forward**: **Enhance infrastructure** at HWCs and recruit more **trained healthcare personnel** to ensure effective service delivery.

4. **Monitoring and Fraud Prevention**:
- o **Challenge**: Preventing misuse and fraud in healthcare claims.
- o **Way Forward**: **Strengthen monitoring mechanisms** with technology-driven solutions to prevent fraud and ensure accountability.

5. **Financial Sustainability**:
- o **Challenge**: Balancing the expansion of benefits with financial sustainability.
- o **Way Forward**: Explore **public-private partnerships** and **alternative funding sources** to maintain sustainable financing for the scheme.

Mission for Integrated Development of Horticulture (MIDH)

Syllabus: Government Schemes – Agriculture and Horticulture, Modern Farming Techniques, Sustainable Development in Agriculture

Context: **The Union Government has decided to expand the** Mission for Integrated Development of Horticulture (MIDH) **by integrating advanced agricultural practices such as** hydroponics, aquaponics, vertical farming, **and** precision agriculture. **This modernization aims to increase** horticultural productivity, **improve** resource efficiency, **and meet the demands from states for updated** cost norms and guidelines.

About Mission for Integrated Development of Horticulture (MIDH)

1. **Origin**:
- o **Launch**: MIDH was established by the **Government of India** as a **Centrally Sponsored Scheme (CSS)** to boost the horticulture sector.
- o **Objective**: Focuses on the **holistic development** of horticulture, covering production, post-harvest management, processing, and marketing.

2. **Ministry**:
- o **Implementing Body**: The scheme is implemented by the **Ministry of Agriculture and Farmers Welfare**.

3. **Aims and Objectives**:

- o **Promote Horticultural Growth**: Encourage the production of **diverse horticultural crops**, including fruits, vegetables, flowers, and medicinal plants.
- o **Support for Post-Harvest Management**: Ensures that horticulture produce is well-preserved, with facilities for **processing, storage, and marketing**.
- o **Modern Techniques**: Expands horticulture practices through advanced techniques such as **hydroponics, aquaponics, and precision agriculture**.

4. **Key Sub-Schemes**:
- o **National Horticulture Mission (NHM)**: Aimed at boosting horticulture crop production and productivity across India.
- o **Horticulture Cluster Development Programme (HCDP)**: Focuses on creating **clusters for high-value horticulture** to enhance value chains.
- o **Technology Mission for Development in NE States, Sikkim, and J&K**: Targets **horticulture development in the northeastern states** and hill areas.
- o **National Bamboo Mission**: Promotes bamboo cultivation, processing, and marketing to support **economic and environmental sustainability**.
- o **Coconut Development Board**: Dedicated to the integrated development of **coconut cultivation and industry**.
- o **Mission for Integrated Development of Medicinal Plants (MIDMP)**: Supports the cultivation and sustainable management of **medicinal plants** in India.

Advanced Horticulture Techniques Integrated in MIDH

1. **Hydroponics**:
- o **Method**: A **soil-free cultivation method** where plants are grown in a **nutrient-rich water solution**.
- o **Benefits**: Allows controlled environment agriculture, higher yields, and is suitable for urban and limited spaces.
- o **Environmental Impact**: Reduces the need for pesticides and water, supporting sustainable agriculture.

2. **Aquaponics**:
- o **Method**: Combines **aquaculture (fish farming)** and **hydroponics**; fish waste provides nutrients for plants, while plants purify water for fish.
- o **Benefits**: Creates a **closed-loop system**, conserving water and recycling nutrients efficiently.
- o **Application**: Suitable for integrated farming systems, producing both fish and crops in a sustainable manner.

3. **Vertical Farming**:
- o **Method**: A method of farming in **stacked layers**, usually indoors, using **LED lighting** and a controlled environment.
- o **Benefits**: Maximizes crop output in urban and space-constrained areas, reducing the need for land.
- o **Environmental Impact**: Reduces water and pesticide use, enabling year-round production in urban environments.

4. **Precision Agriculture**:

- Method: Utilizes technology like **GPS, IoT sensors, and data analysis** to monitor and manage farming inputs such as water, fertilizers, and pesticides.
- Benefits: Increases **resource-use efficiency** by applying inputs precisely where needed, optimizing crop yields.
- Application: Helps in **real-time monitoring of crops** and contributes to sustainable agricultural practices.

Significance of MIDH Expansion with Modern Techniques

1. **Enhanced Productivity**:
   - **Higher Yields**: The adoption of advanced techniques is expected to **increase yield per unit area** and meet the rising demand for horticultural produce.
   - **Efficient Land Use**: Methods like vertical farming allow for maximum output from limited space, especially in urban areas.
2. **Resource Efficiency and Environmental Sustainability**:
   - **Water Conservation**: Techniques like hydroponics and aquaponics use **significantly less water** than traditional farming.
   - **Reduced Chemical Use**: Precision agriculture minimizes **pesticide and fertilizer usage**, benefiting the environment and improving soil health.
3. **Support for Small and Marginal Farmers**:
   - **Reduced Input Costs**: Precision agriculture and controlled-environment techniques help farmers optimize input costs, making farming more affordable and efficient.
   - **Access to Modern Markets**: Cluster development programs and post-harvest support empower small farmers by connecting them to modern supply chains and high-value markets.
4. **Economic Growth and Employment**:
   - **Rural Employment**: Expanding horticulture with modern techniques provides **employment opportunities** in rural areas.
   - **Value Chain Development**: MIDH supports post-harvest management, processing, and marketing, contributing to **value-added products** and economic growth.
5. **Climate Resilience and Food Security**:
   - **Resilience to Climate Variability**: Controlled-environment techniques in vertical farming and hydroponics protect crops from weather variations, ensuring **steady production**.
   - **Food Security**: Increased horticulture productivity supports **food and nutritional security**, enhancing availability of fruits, vegetables, and other horticultural produce.

Challenges and Way Forward

1. **High Initial Investment**:
   - **Challenge**: Advanced techniques like vertical farming and hydroponics require significant initial investment.
   - **Way Forward**: Government subsidies and easy access to loans for farmers adopting modern methods can encourage participation.
2. **Technical Know-How**:

- o **Challenge**: Farmers need **training and technical skills** to implement advanced techniques effectively.
- o **Way Forward**: Conduct training programs, workshops, and digital resources for skill-building and knowledge-sharing.

3. **Infrastructure and Supply Chain Development**:
- o **Challenge**: Limited infrastructure and storage facilities lead to post-harvest losses.
- o **Way Forward**: Strengthen cold storage, transportation, and processing infrastructure through public and private investment.

4. **Regulation and Standards**:
- o **Challenge**: Ensuring the quality and safety of produce grown with new techniques.
- o **Way Forward**: Establish guidelines and quality standards for horticultural produce cultivated using modern methods to maintain safety and consistency.

Pradhan Mantri MUDRA Yojana (PMMY) and Introduction of Tarun Plus

Syllabus: Government Policies and Interventions – Financial Inclusion, Self-Employment, Small-Scale Enterprises

Context: In July 2024**, the finance minister announced the creation of a new loan category called** Tarun Plus **under the** Pradhan Mantri MUDRA Yojana (PMMY)**, with a loan limit raised to** ₹20 lakh **effective from** October 24, 2024**. This new category aims to support** successful Tarun borrowers **by offering additional financial assistance for business expansion.**

About Pradhan Mantri MUDRA Yojana (PMMY)

1. **Origin**:
- o **Launch Date**: PMMY was launched on **April 8, 2015**.
- o **Ministry**: Implemented under the **Ministry of Finance**.
2. **Objective**:
- o **Financial Inclusion and Self-Employment**: PMMY aims to promote **financial inclusion** by extending **credit to small-scale enterprises** in **manufacturing, trading, and services**, including allied agricultural activities.
- o **Focus on Small Entrepreneurs**: Designed to empower **micro-entrepreneurs** by providing them with the financial resources needed to start or expand their businesses.
3. **Loan Categories**:
- o **Shishu**:
  - ▪ **Loan Limit**: Up to **₹50,000**.
  - ▪ **Purpose**: For **nascent businesses** requiring small capital for setup.
- o **Kishore**:
  - ▪ **Loan Limit**: Between **₹50,000 and ₹5 lakh**.
  - ▪ **Purpose**: For businesses in the early growth phase that need **additional capital**.
- o **Tarun**:
  - ▪ **Loan Limit**: Above **₹5 lakh up to ₹10 lakh**.
  - ▪ **Purpose**: For **mature businesses** looking to expand or upgrade.

- Tarun Plus (New Category):
  - Loan Limit: From ₹10 lakh to ₹20 lakh.
  - Eligibility: Targeted at successful Tarun borrowers seeking larger financial support to further grow their businesses.
4. Member Lending Institutions (MLIs):
  - Diverse Lenders: PMMY loans are disbursed by Scheduled Commercial Banks, Regional Rural Banks (RRBs), Small Finance Banks (SFBs), Non-Banking Financial Companies (NBFCs), and Micro Finance Institutions (MFIs).

Key Features of PMMY

1. Collateral-Free Loans:
   - Unsecured Credit: Loans are collateral-free, ensuring easier access to funds without the need for security. This feature particularly benefits small entrepreneurs who lack assets to offer as collateral.
2. MUDRA Card:
   - RuPay Debit Card: Provides a flexible working capital facility that allows borrowers to access their loan amount conveniently.
   - Overdraft Facility: Functions as an overdraft card, enabling users to access credit and make payments as needed, providing greater flexibility in cash flow management.
3. MUDRA MITRA App:
   - Mobile App: Offers information, guidance, and resources on MUDRA loans.
   - Support for Entrepreneurs: Assists aspiring entrepreneurs by providing loan-related information and helping them navigate the loan process.

Significance of Tarun Plus Category

1. Support for Established Micro-Enterprises:
   - Expansion Capital: By raising the loan limit to ₹20 lakh, the Tarun Plus category offers additional financial support for businesses that have already benefited from the Tarun category, promoting sustainable growth.
2. Promotes Business Upgradation and Expansion:
   - Further Growth Potential: Tarun Plus provides successful Tarun borrowers with the opportunity to upgrade technology, expand operations, or diversify their offerings.
3. Enhanced Financial Inclusion:
   - Wider Credit Access: Expanding the loan limit enhances financial inclusion by allowing micro and small businesses access to larger funds, supporting their growth and resilience.
4. Boost to Self-Employment:
   - Job Creation: The additional funding for successful micro-businesses can stimulate job creation, contributing to economic growth and employment.

Challenges in Implementing PMMY

1. High NPAs (Non-Performing Assets):
   - Risk of Defaults: As PMMY loans are unsecured, there is a higher risk of default, especially among new entrepreneurs who may struggle to repay.

2. **Quality of Loan Utilization**:
   - **Lack of Business Skills**: Some beneficiaries may lack essential business skills, which can affect their ability to manage funds effectively and repay the loan.
3. **Low Financial Literacy**:
   - **Limited Awareness**: Many small entrepreneurs are not fully aware of loan management and budgeting, leading to **misuse of funds** and financial strain.
4. **Operational Challenges**:
   - **High Demand vs. Processing Capacity**: Financial institutions often face challenges in processing high loan volumes, which can lead to delays.

Ayushman Vaya Vandana Card for Senior Citizens' Healthcare

*Syllabus**: Government Schemes and Interventions – Health, Social Welfare, Financial Inclusion, Senior Citizens' Welfare**

Context: **The** Ayushman Vaya Vandana Card **was recently launched as an extension of the** Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY)**. This initiative aims to provide** free healthcare **to citizens aged** 70 years and above**, offering an annual coverage of up to** ₹5 lakh **to ensure access to necessary treatments without financial strain.**

About the Ayushman Vaya Vandana Card

1. **Origin**:
   - **Announcement**: Introduced in the **Union Budget 2024-25** as part of an expansion in health coverage for senior citizens.
   - **Ministry**: Operates under the **Ministry of Health and Family Welfare**.
2. **Aim**:
   - **Universal Healthcare for Senior Citizens**: Ensures that individuals above **70 years of age** have access to **free, quality healthcare** for essential treatments, alleviating the financial burden on elderly citizens and their families.
3. **Eligibility**:
   - **Age Criteria**: Available to **all Indian citizens aged 70 years or older**, regardless of income or economic status, ensuring **inclusive healthcare access**.
4. **Key Features**:
   - **Annual Coverage**:
     - Provides **₹5 lakh annual health cover** per family for healthcare needs.
     - **Shared Coverage**: If multiple eligible senior citizens reside in one household, the coverage can be shared.
   - **Enrolment Process**:
     - **Registration**: Eligible citizens can register via the **PM-JAY portal** or the **Ayushman app**.
     - **eKYC Requirement**: Mandatory **electronic Know Your Customer (eKYC)** completion, even for those who already hold an Ayushman Bharat card, to verify eligibility.
   - **Integration with Other Health Schemes**:
     - Beneficiaries of other government health schemes, such as **CGHS (Central Government Health Scheme)** and **ECHS (Ex-Servicemen Contributory Health**

Scheme), have the option to either retain their existing coverage or switch to the Ayushman Bharat benefits.
- o **Additional Support for Existing Insured Individuals**:
    - Available to individuals covered under **Employees State Insurance Corporation (ESIC)** and those with **private health insurance**.

Significance of Ayushman Vaya Vandana Card

1. **Enhanced Healthcare Access for Senior Citizens**:
   - o **Comprehensive Health Coverage**: The card ensures that senior citizens, a group vulnerable to various health issues, can access **free, quality healthcare** without the worry of incurring out-of-pocket expenses.
   - o **Financial Relief**: Offers **financial security** by covering treatment costs, reducing the healthcare burden on elderly individuals and their families.
2. **Universal Health Coverage for All Senior Citizens**:
   - o **Inclusivity**: Unlike other health schemes that may have income criteria, this card provides coverage **regardless of economic status**, promoting **equitable healthcare access** for all senior citizens.
3. **Integration with Existing Schemes**:
   - o **Flexibility**: Senior citizens covered under **CGHS, ECHS, ESIC**, or private insurance can choose to retain their coverage or avail of Ayushman Bharat benefits, providing them with flexibility in health coverage options.
4. **Streamlined Access through Digital Enrolment**:
   - o **eKYC Verification**: The mandatory eKYC process ensures accurate identification and prevents **duplication of benefits**, making the enrolment process transparent and efficient.
   - o **Digital Convenience**: The availability of enrolment via the **PM-JAY portal and Ayushman app** enables senior citizens or their families to register conveniently.
5. **Support for Co-Living Elderly Households**:
   - o **Shared Benefits**: Families with multiple eligible senior citizens benefit from **shared coverage**, ensuring that healthcare needs across the household are met effectively.

Challenges and Way Forward

1. **Digital Literacy and Enrolment Challenges**:
   - o **Challenge**: Many senior citizens may face **difficulties with digital enrolment** and eKYC requirements.
   - o **Solution**: Facilitate enrolment through **community health centers** or **Common Service Centers (CSCs)** with on-ground assistance.
2. **Awareness and Outreach**:
   - o **Challenge**: Limited awareness among senior citizens about the new Ayushman Vaya Vandana Card may restrict uptake.
   - o **Solution**: Conduct **awareness campaigns** in regional languages through radio, newspapers, and community outreach programs.
3. **Ensuring Quality of Healthcare**:
   - o **Challenge**: Ensuring that empaneled hospitals maintain high-quality healthcare standards.

- Solution: Implement **regular audits and quality assessments** of empaneled hospitals to ensure compliance with healthcare standards.
4. **Integration with State-Level Health Schemes**:
   - **Challenge**: Avoiding overlaps with state-specific healthcare programs can be complex.
   - **Solution**: Coordinate with **state governments** to streamline benefits and avoid duplication while enhancing the efficiency of the healthcare delivery system.
5. **Extended Healthcare Network in Rural Areas**:
   - **Challenge**: Limited access to healthcare facilities in rural regions may hinder the card's impact in these areas.
   - **Solution**: Expand the network of **empaneled hospitals** and strengthen **telemedicine services** in rural areas to bridge the accessibility gap.

Aarambh 6.0 Initiative

Context: Prime Minister Narendra Modi recently engaged with young civil servants **during the** Aarambh 6.0 orientation program**, focusing on enhancing governance through** public participation **(Jan Bhagidari) and improving** feedback and grievance redressal **systems. This initiative underscores the role of** citizen-centric governance **and responsive public administration.**

About Aarambh 6.0 Initiative

1. **Objective**:
   - **Orientation for Civil Servants**: Aarambh is a program aimed at equipping **young civil servants** with governance skills and encouraging **innovative thinking**.
2. **Focus Areas**:
   - **Jan Bhagidari (Public Participation)**: Emphasizes the **importance of public involvement** in governance, ensuring that policies reflect the needs and aspirations of citizens.
   - **Feedback and Grievance Redressal**: Focuses on establishing robust **feedback mechanisms** and streamlined systems for addressing grievances, enhancing transparency and accountability.

Namo Drone Didi Scheme: Empowering Women in Agriculture with Drone Technology

Context: The Government of India **has launched the** Namo Drone Didi **scheme under the** Deendayal Antyodaya Yojana – National Rural Livelihood Mission (DAY-NRLM)**. This initiative aims to empower women** Self-Help Groups (SHGs)**by providing drones to support agricultural activities, enhancing income opportunities and farming efficiency.**

About the Namo Drone Didi Scheme

1. **Objective**:

- The scheme seeks to empower **women SHGs** by enabling them to use **drones** for agricultural services, creating new income streams and improving **farming efficiency**.

2. **Administration**:
- **Department of Agriculture & Farmers' Welfare, Ministry of Agriculture**: Oversees the scheme in partnership with the **Ministry of Rural Development**.

3. **Features**:
- **Financial Assistance**: Covers **80% of the drone cost**, with a maximum cap of **₹8 lakh per drone**.
- **Loan Assistance**: SHGs can obtain loans for the remaining cost via the **National Agriculture Infrastructure Fund (AIF)** with a **3% interest subvention**.
- **Drone Package**: Includes drones with spray systems, additional battery sets, pilot and assistant training, a **one-year warranty**, two years of maintenance, and insurance.
- **Training and Support**: SHG members undergo a **15-day training** program for drone operation, maintenance, and agricultural use.

4. **Implementation and Monitoring**:
- **State-Level Lead Fertilizer Companies (LFCs)** and **State Departments** manage the scheme's implementation, allocating drones to SHG clusters.
- **MIS Drone Portal**: An IT-based **Management Information System (MIS)** portal will monitor drone operations and ensure efficient service delivery.

Significance of the Namo Drone Didi Scheme

1. **Empowering Women in Rural Areas**:
- By enabling women SHGs to operate and manage drones, the scheme promotes **financial independence** and **technical skills development** among rural women, contributing to **gender empowerment**.

2. **Agricultural Efficiency and Innovation**:
- Drones facilitate **precision agriculture** by offering efficient crop spraying, real-time crop health monitoring, and data collection, enhancing **productivity and resource optimization**.

3. **Economic Upliftment**:
- The scheme provides a new source of income for SHGs, aligning with the objectives of **DAY-NRLM** to uplift rural livelihoods and improve economic conditions for marginalized communities.

4. **Supporting Climate-Smart Agriculture**:
- By integrating drones, the scheme promotes **sustainable farming** practices, helping farmers make data-driven decisions, optimize inputs, and reduce resource wastage.

ART & CULTURE

Dinosaur Fossil Park and Museum, Balasinor – Challenges and Conservation Efforts

*Syllabus: **Art and Culture – Heritage Sites, Geo-Heritage, Conservation of Fossils and Museums, Role of UNESCO***

Context: The Dinosaur Fossil Park and Museum in Balasinor, Gujarat, **known for its remarkable dinosaur fossils, is a significant geo-heritage site currently seeking** UNESCO geo-heritage status**. However, the site faces issues in** maintenance and conservation, **impacting both the visitor experience and the preservation of fossil remains.**

About Dinosaur Fossil Park and Museum, Balasinor

1. **Location**:
   o Situated in **Raiyoli**, near **Balasinor** in Gujarat, this park is recognized for **Late Cretaceous** dinosaur fossils, including the fossils of **Rajasaurus narmadensis**, an Indian dinosaur species.
2. **Discovery**:
   o The fossil-rich site was **discovered in the 1980s** by geologists from the **Geological Survey of India (GSI)**.
   o Known for being one of the **largest dinosaur egg hatcheries globally**, the site has substantial scientific importance.
3. **Museum Facilities**:
   o Features **3D mapping** and **virtual reality (VR) tours** to enhance the visitor experience.
   o However, the museum faces structural issues such as **broken displays**, **overgrown vegetation**, and **frequent power outages**, diminishing its appeal.
4. **Significance**:
   o Apart from showcasing **prehistoric life**, Balasinor's fossils have the potential to **boost paleontological tourism** and serve as an educational resource for students and researchers.
   o **UNESCO geo-heritage status** would provide international recognition, bringing focus to its **scientific and cultural importance**.

Challenges Faced by the Dinosaur Fossil Park and Museum

1. **Neglect and Poor Maintenance**:
   o **Inadequate upkeep** with **overgrown vegetation**, **broken exhibits**, and **lack of regular power** compromises both conservation and visitor experience.
   o Issues like **insufficient security** and **lack of informational signage** further reduce accessibility and understanding.
2. **Nearby Developmental Threats**:

- o An **irrigation project** close to the fossil site poses risks by potentially disturbing the **fossil-bearing rock layers**.
- o Unregulated **construction and excavation activities** may damage undiscovered fossils.

3. **Funding and Structural Issues**:
   - o **Delays in funding** have hampered the timely development and repair of museum infrastructure.
   - o Without adequate financial support, **restoration** and **modernization** efforts have stalled, affecting both fossil preservation and educational programs.

4. **Lack of Awareness and Promotion**:
   - o Limited **promotion and awareness campaigns** reduce visitor interest and local engagement.
   - o The park has yet to reach its full potential as a **paleontological tourist attraction**.

Local Conservation Efforts

1. **Fossil Park Society**:
   - o This society coordinates **conservation efforts** and **public engagement activities** to maintain the site.
   - o Ensures that basic maintenance tasks are performed, though **resource limitations** affect the scope of their work.

2. **Nawabzadi Aaliya Sultana Babi**:
   - o Also known as the **"Dinosaur Princess"**, she actively advocates for the **conservation of Balasinor's fossils**.
   - o Aaliya Sultana Babi has been instrumental in **raising awareness** and promoting the site's heritage value at national and international levels.

Significance of UNESCO Geo-Heritage Status

1. **International Recognition**:
   - o **UNESCO designation** would highlight Balasinor as an important site for both scientific study and tourism, elevating its status globally.
   - o This status would likely attract **international researchers** and tourists, further supporting conservation efforts.

2. **Enhanced Conservation Efforts**:
   - o **Geo-heritage status** would bring additional **funding and resources** for the preservation and management of fossils.
   - o UNESCO's involvement could help address infrastructure issues and improve **site security** and **visitor facilities**.

3. **Increased Tourism and Education**:
   - o Recognition could transform the site into a major **tourism and educational hub**.
   - o **Educational programs** and **paleontological research** initiatives could expand, making Balasinor a leading destination for fossil tourism.

Case Study: Hong Kong's Dinosaur Fossil Discovery

- **Location**: First-ever dinosaur fossils discovered on **Port Island** in Hong Kong's **UNESCO Global Geopark**.
- **Significance**: These fossils are likely from the **Cretaceous period** (145-66 million years ago) and were preserved by **sedimentary layers** exposed due to **flooding**.
- **Implications**: Demonstrates the importance of **geopark conservation** in uncovering hidden geological and paleontological sites.
- **Comparison**: Hong Kong's discovery underlines the potential benefits of **UNESCO recognition** for sites like Balasinor, emphasizing the value of conservation for scientific discovery.

Way Forward for Dinosaur Fossil Park and Museum

1. **Securing Funding and Resources**:
   - **Increased government funding** for infrastructure upgrades and maintenance.
   - **Public-private partnerships** to attract investments and support modern conservation practices.
2. **Improving Visitor Facilities**:
   - Renovating museum infrastructure, adding **signage, security** and **information kiosks** to enhance visitor engagement.
   - Ensuring **basic amenities** like electricity, seating, and safety measures for a better visitor experience.
3. **Enhanced Promotion and Awareness**:
   - **Local outreach programs** and **national campaigns** to boost awareness about the significance of Balasinor's fossils.
   - Collaboration with educational institutions to encourage **student field trips** and **research projects**.
4. **Integrating with Regional Tourism**:
   - Position the fossil park as a **central attraction** in Gujarat's tourism circuit.
   - Create **tourist packages** and work with tour operators to make the site more accessible and attractive to visitors.
5. **Advocating for UNESCO Status**:
   - Actively pursue **UNESCO geo-heritage status** to attract global recognition and additional conservation resources.
   - Engage with UNESCO officials and prepare documentation to showcase the site's **scientific and cultural importance**.