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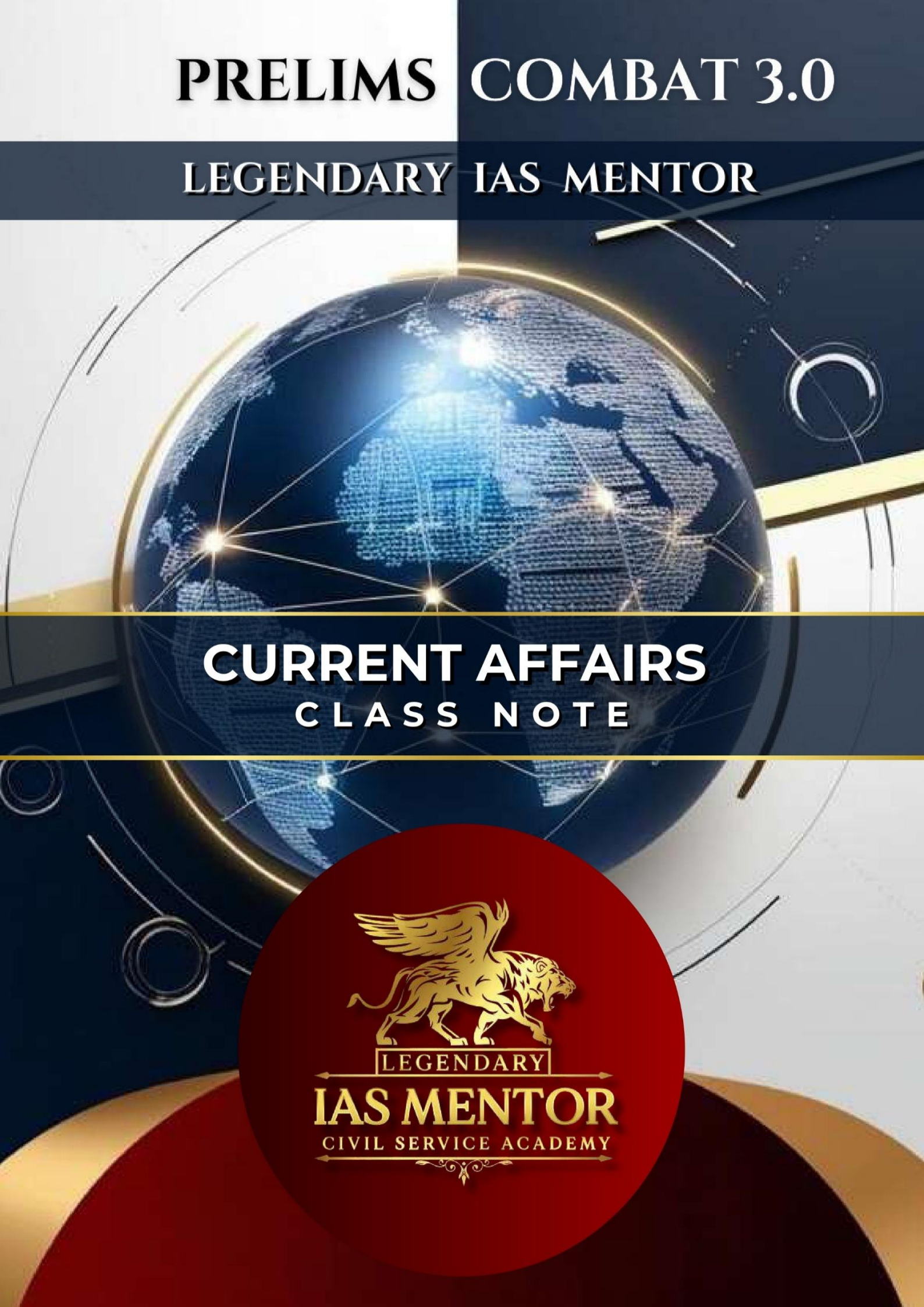

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1. Hornbill Festival

- The Prime Minister recently congratulated the people of Nagaland on completion of 25 years of Hornbill Festival.
- The Hornbill Festival also called the 'Festival of Festivals', is a celebration held every year from 1 to 10
- December, in Nagaland. The theme for Hornbill Festival 2024 was "Cultural Connect".
- The 10-day festival, which also coincides with the Statehood Day of Nagaland, is an annual tourism promotional event to showcase Nagaland's rich cultural heritage in all its ethnicity, and diversity.
- Nagaland attained statehood with the enactment of the State of Nagaland Act in 1962 by Parliament and the state of Nagaland was formally inaugurated on December 1, 1963.
- The festival is a tribute to the great Hornbill, which is the most admired and revered bird for the Nagas for its qualities of alertness and glory. It is celebrated at Naga Heritage Village, Kisama which is about 12 km from Kohima in Nagaland.
- The majestic bird is closely identified with the social and cultural life of the Nagas as reflected in tribal folklore, dances and songs.
- The festival is a cultural exhibition to revive, protect and preserve the richness and uniqueness of the Naga heritage, while for the visitors to this event it is a means to comprehensively understand the Naga people, their land and culture.

2. Parker Solar Probe

NASA scientists announced that the Parker Solar Probe survived the closest-ever approach to the Sun.

UPSC CSE Prelims Perspective

Parker Solar Probe

- **Launch**: 2018 by NASA under the *Living with a Star* program.
- **Objective**: Study the Sun's corona (outer atmosphere) and understand:
    1. **Coronal Heating Problem**: Why the corona is hotter than the Sun's surface (~5,500°C).
    2. **Solar Wind Acceleration**: Explore why charged particles accelerate to high speeds.
- **Key Features**:
    1. **Closest Approach**: Ventures into the Sun's corona, closer than any spacecraft.
    2. **Heat Shield**: Withstands extreme temperatures (up to 1,377°C).
    3. **Instruments**:
        - FIELDS: Measures magnetic fields.
        - SWEAP: Studies solar wind (plasma).
        - WISPR: Captures images of the Sun's corona.
        - ISIS: Analyzes high-energy particles.

Significance:

- Improves understanding of solar activity and space weather, crucial for satellite operations and power grids.

Related Mission:

- *Aditya-L1 (India)*: Complements Parker's findings by studying the Sun's photosphere, chromosphere, and corona.

Mains Perspective

Parker Solar Probe – Importance in Solar Physics

1. **Scientific Objectives**:
    - **Coronal Heating Problem**: Understanding why the Sun's corona is millions of degrees hotter than its surface (~5,500°C).
    - **Solar Wind Acceleration**: Exploring mechanisms behind charged particles' rapid acceleration, influencing space weather.
2. **Technological Innovations**:
    - Advanced thermal protection systems like heat shields.
    - Instruments like FIELDS (for magnetic fields), SWEAP (plasma study), WISPR (imaging), and ISIS (energetic particles).
3. **Implications**:
    - **Space Weather**: Improved forecasting of solar storms, crucial for satellite operations, GPS, and power grids.
    - **Astrophysics**: Enhances understanding of stellar processes and solar-terrestrial interactions.
4. **Global Context**:
    - Collaboration with missions like India's *Aditya-L1* for a holistic understanding of the Sun.
    - Benefits for space exploration by safeguarding technology and astronauts from solar activity.
5. **Challenges**:
    - High temperatures, solar radiation, and spacecraft durability.
    - Long-term data analysis and integration with other solar research missions.

Value Addition:

- **Keywords**: Coronal heating, solar wind, space weather, Living with a Star, Aditya-L1.
- **GS Linkages**:
    - *GS Paper 3*: Science and Technology (space missions, innovations).
    - *GS Paper 1*: Geography (impact of solar activity on Earth).

3.The Space Docking Experiment (SpaDeX)

A significant technological milestone achieved by the Indian Space Research Organisation (ISRO), demonstrating India's capability in autonomous in-orbit docking—a critical technology for advancing space exploration and operations.

Key Features of SpaDeX:

- **Mission Components:** SpaDeX involves two small spacecraft, SDX01 (Chaser) and SDX02 (Target), each weighing approximately 220 kg. Both spacecraft were launched together aboard the Polar Satellite Launch Vehicle (PSLV) on December 30, 2024, into a 475 km circular orbit. The experiment is part of ISRO's broader strategy to develop Next-Generation Space Technologies.
- **Docking Process:** The Chaser spacecraft performed a series of complex maneuvers to rendezvous with and dock to the Target spacecraft. This required reducing the relative distance from 20 km to just a few centimeters, showcasing precise navigation and control. Satellites were maneuvered from a 15m hold point to a 3m distance for precision docking, with automated systems using sensors, alignment mechanisms, and thrusters to complete the process. Post-docking operations included power transfer checks and payload activation.
- **Technological Innovations:** The mission successfully demonstrated several critical technologies, including autonomous rendezvous and docking, rigidization for stability post-docking, electrical power transfer between docked spacecraft, and integrated spacecraft control using the attitude control system of one spacecraft while docked.

Relevance and Significance:

- **Strategic Milestone:** With the successful execution of SpaDeX, India became the fourth country, after the USA, Russia, and China, to achieve autonomous in-orbit docking. This achievement solidifies India's position in the global space community.
- **Foundation for Future Missions:** The technologies validated through SpaDeX are essential for several future missions, such as the human spaceflight program (Gaganyaan), in-orbit satellite servicing, and the establishment of the Bharatiya Antariksha Station (Indian Space Station), planned for 2035. Additionally, SpaDeX supports advanced missions like moon landings and space station assembly.

Future Prospects:

- **Advanced Docking Missions:** ISRO aims to undertake more complex docking missions involving larger spacecraft and intricate operations. These will further refine and validate docking technologies.
- **Human Spaceflight and Space Station Development:** The expertise gained from SpaDeX is directly applicable to India's human spaceflight program, Gaganyaan, as well as the Bharatiya Antariksha Station. These capabilities are critical for tasks such as crew transfer, resupply missions, and modular space station assembly.

Comparison with Other Nations:

- **United States:** First achieved docking technology during the Gemini program in 1966.
- **Russia:** Demonstrated docking during the Soyuz missions.
- **China:** Successfully docked modules for the Tiangong space station.
- **India:** Became the fourth nation to achieve this milestone in 2025 with SpaDeX.

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4.Quantum Computing and Willow Chip:

Working of Quantum Chips

Quantum chips like Willow leverage the principles of **quantum mechanics**, particularly **superposition** and **entanglement**, to process information.

- **Qubits vs Classical Bits:**
  Unlike classical bits (0 or 1), **qubits** can exist in multiple states simultaneously (0, 1, or a combination), enabling massive parallelism and the ability to solve complex problems exponentially faster.
- **Superconducting Transmon Qubits:**
  Willow uses **transmon qubits**, which are tiny superconducting circuits designed to behave like artificial atoms. These circuits operate at ultra-low temperatures, maintained using dilution refrigerators, to minimize noise and maximize quantum coherence.
- **Parallel Processing:**
  Quantum chips process information in **parallel and asynchronous modes**, inspired by neural networks in AI. This significantly reduces the time needed for computation compared to classical methods.

Principles Underpinning Quantum Computing

- **Superposition:**
  A single qubit can represent multiple states at once, allowing quantum computers to evaluate all possible solutions to a problem simultaneously.
- **Entanglement:**
  Qubits in an entangled state are interdependent; the state of one qubit instantaneously influences another, enabling highly coordinated calculations.

- **Quantum Tunneling:**
  Quantum chips can "tunnel" through energy barriers, making it easier to find optimal solutions in complex mathematical problems.
- **Error Correction Techniques:**
  Willow integrates **advanced error correction** to overcome quantum decoherence (loss of quantum state) and noise, two significant hurdles in quantum computing.

Potential Opportunities

a) Science and Technology

- **Drug Discovery:**
  Quantum computers can simulate molecular interactions and predict the properties of drugs with unprecedented precision, revolutionizing healthcare and pharmaceuticals.
- **Fusion Energy:**
  Quantum simulations can optimize fusion reactor designs, accelerating the pursuit of clean and abundant energy.
- **Battery Design:**
  Quantum computing aids in designing more efficient energy storage systems, critical for electric vehicles and renewable energy integration.

b) National Security and Defense

- Quantum computing strengthens **cryptographic systems** or aids in breaking existing cryptographic standards, potentially reshaping cybersecurity strategies.

c) Artificial Intelligence and Machine Learning

- Quantum computing enhances optimization and pattern recognition tasks, enabling breakthroughs in machine learning models.

d) Climate Modelling:

By simulating complex systems like weather and ocean currents, quantum computers can provide better climate predictions and insights into mitigating climate change.

e) Space Exploration:

Quantum algorithms can assist in trajectory optimization, material science, and deep-space communication technologies.

Qubits: Properties and Role

- **Unique Properties:**
    - Superposition and entanglement enable exponential scaling in computational power.
    - Quantum states must be **isolated** from external disturbances to maintain coherence.
- **Scaling Challenge:**
  Building a system with millions of qubits that maintain coherence is a major engineering challenge. Willow uses transmon qubits to address this.

Error Correction in Willow Chip

- **Significance of Error Correction:**
  Quantum systems are inherently prone to noise and decoherence. Effective error correction is crucial for achieving stable, large-scale quantum systems.
- **Approach in Willow:**
    - Incorporates **redundancy** by using multiple physical qubits to create a single logical qubit.

- Employs advanced algorithms to detect and rectify errors without disturbing quantum states.

Challenges in Quantum Computing

a) Technical Challenges

1. **Decoherence:**
   Qubits lose their quantum state quickly due to environmental interactions, limiting the system's reliability.
2. **Error Rates:**
   Even small errors can cascade, rendering calculations invalid without robust error correction.
3. **Scalability:**
   Building and controlling millions of qubits while maintaining coherence is extremely complex.
4. **Temperature Sensitivity:**
   Superconducting qubits require ultra-cold temperatures, increasing infrastructure costs.

b) Ethical and Security Challenges

1. **Cybersecurity Threats:**
   Quantum computing may render existing encryption techniques obsolete, exposing sensitive data to vulnerabilities.
2. **Dual-Use Concerns:**
   Quantum technologies can be misused for malicious purposes, such as breaking encryption or weaponizing AI.

c) Economic and Policy Challenges

1. **Cost:**
   Developing and deploying quantum systems is capital-intensive.
2. **Regulatory Oversight:**
   Quantum technologies require robust international regulations to prevent misuse and ensure equitable access.

Quantum Computing in India: Relevance and Strategy

- **India's Initiatives:**
  - Under the **National Quantum Mission**, India aims to develop indigenous quantum technologies in fields like cryptography, communication, and computing.
  - Collaboration with global tech giants like Google can accelerate India's progress.
- **Strategic Importance:**
  - Quantum computing aligns with India’s goals in science, defense, and sustainable development.
  - Developing indigenous quantum systems will reduce dependency on foreign technology and bolster cybersecurity.

5. IPBES Nexus Assessment Report

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has released the **Nexus Assessment Report** on the interlinkages among biodiversity, water, food, and health. This report provides crucial insights for decision-makers on addressing interconnected global challenges.

Key Highlights of the Report

1. **Comprehensive Assessment of Nexus Elements:**
    - The report explores interconnections across five key elements: climate change, biodiversity loss, food insecurity, water scarcity, and health risks.
    - It identifies the cascading effects of economic activities on these elements and quantifies unaccounted costs at $10-25 trillion annually.
2. **Trade-offs and Synergies:**
    - **Trade-offs:** Economic activities like increasing agricultural production for food security often harm biodiversity and deplete water resources.
    - **Synergies:** Opportunities exist for integrated actions with positive outcomes across multiple areas. For example, agroforestry practices can enhance biodiversity, improve water retention, and secure livelihoods.
3. **Policy Recommendations:**
    - Promote cross-sectoral governance to manage interdependencies among biodiversity, water, food, and health.

- Encourage sustainable agricultural practices and nature-based solutions.
- Increase investments in biodiversity conservation to mitigate climate impacts and secure ecosystem services.

About IPBES

1. **Establishment and Mandate:**
   - Founded in 2012 in Panama City by 94 governments, IPBES is headquartered in Bonn, Germany.
   - It aims to strengthen the science-policy interface for biodiversity and ecosystem services, promoting sustainable development and long-term human well-being.
2. **Structure and Role:**
   - Independent intergovernmental organization, receiving secretariat services from the United Nations Environment Programme (UNEP) without being a UN body.
   - Often referred to as the IPCC for biodiversity due to its role in providing scientific assessments.
3. **Key Publications:**
   - **Global Assessment Report on Biodiversity and Ecosystem Services (2019):** Highlighted the alarming rate of biodiversity loss globally.
   - **Assessment Report on Sustainable Use of Wild Species (2022):** Provided insights into sustainable utilization of wild species.
   - **Assessment Report on Invasive Alien Species and Their Control (2023):** Focused on managing the threats posed by invasive species.

- **Nexus Assessment Report (2024):** Addresses interlinkages among biodiversity, water, food, and health.

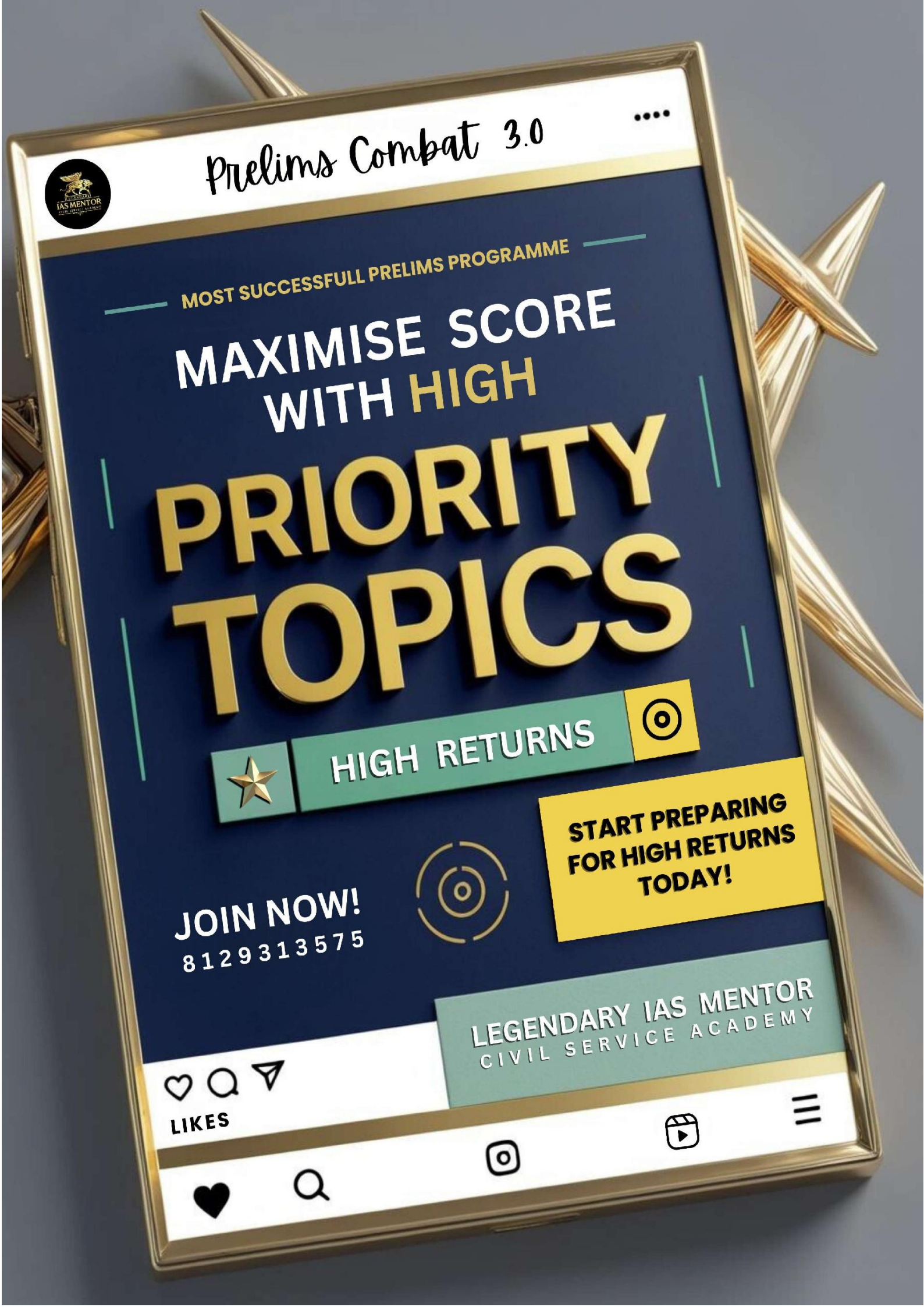
Analysis from GS-3 Perspective

1. **Environmental Conservation:**
   - Recognize the interconnectedness of climate, biodiversity, and ecosystem services.
   - Formulate policies addressing trade-offs in economic activities, ensuring sustainable growth.
2. **Sustainable Development Goals (SDGs):**
   - Links directly to SDGs 2 (Zero Hunger), 6 (Clean Water and Sanitation), 13 (Climate Action), 14 (Life Below Water), and 15 (Life on Land).
   - Highlights the importance of integrated policy frameworks for achieving multiple SDG targets.
3. **Economic Implications:**
   - The report's quantification of unaccounted costs due to biodiversity loss ($10-25 trillion annually) underscores the economic imperative of sustainability.
   - Calls for inclusive growth models that incorporate ecosystem service valuation.
4. **Way Forward for India:**
   - Strengthen biodiversity conservation measures under schemes like the National Biodiversity Action Plan.
   - Promote sustainable agriculture under programs like Paramparagat Krishi Vikas Yojana (PKVY).
   - Enhance cross-sectoral collaboration for achieving Nationally Determined Contributions (NDCs).

- Invest in nature-based solutions to mitigate climate and water-related risks, particularly in vulnerable regions.

Conclusion

The Nexus Assessment Report underscores the urgent need to adopt holistic and integrated approaches to address global challenges. By balancing trade-offs and leveraging synergies, nations can advance biodiversity conservation, mitigate climate change, and ensure food and water security, contributing significantly to sustainable development and human well-being.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6. Emissions from Arctic Tundra

Overview: Recent research indicates that the Arctic Tundra ecosystem has transitioned from a carbon sink to a net source of CO2 and methane (CH4) emissions. This shift is driven by various natural and anthropogenic factors, with significant implications for global climate systems.

Key Factors Contributing to Emissions:

1. **Thawing Permafrost:**
    - Rising temperatures in the Arctic are causing the permafrost—a permanently frozen layer of soil—to thaw.
    - Thawing releases vast amounts of organic matter trapped within the permafrost, which decomposes and emits CO2 and CH4.
        - *Example:* Methane release from Siberian permafrost regions is accelerating due to thaw. Wet tundra areas with waterlogged conditions are hotspots for methane emissions.
2. **Coastal Erosion:**
    - Rising sea levels and reduced sea ice coverage have increased coastal erosion in Arctic regions.
    - Coastal permafrost erosion in areas such as Alaska and Siberia contributes significantly to localized emissions.
3. **Human Activities:**
    - Oil and gas exploration, infrastructure development, and other anthropogenic activities disturb tundra ecosystems.
    - *Example:* Infrastructure projects in Arctic Canada have been linked to increased localized permafrost thaw and emissions.
4. **Wildfires:**

- The Arctic is experiencing more frequent and intense wildfires due to warmer temperatures and drier conditions.
- *Example:* The 2020 "Zombie Fires" in Siberia burned vast areas of permafrost, releasing significant amounts of CO2 and other pollutants into the atmosphere.

5. **Vegetation Changes:**
    - Warmer temperatures and longer growing seasons are altering vegetation patterns in the tundra.
        - Increased shrub growth traps more snow, insulating the soil and promoting permafrost thaw.
        - *Example:* Expansion of shrubs in Alaskan tundra regions has been linked to localized permafrost thaw.
6. **Albedo Effect and Feedback Loops:**
    - Loss of snow and ice cover reduces surface reflectivity (albedo), leading to greater heat absorption.
    - This creates feedback loops that further accelerate warming and emissions.
7. **Rising Temperatures:**
    - The year 2024 recorded the second-highest Arctic surface air temperatures since 1900, exacerbating emissions from all sources.

About the Arctic Tundra:

1. **Geographic Scope:**
    - The Arctic Tundra lies between 66.5°N and 75°N, stretching across regions in Alaska, Canada, Greenland, Scandinavia, and Russia.
2. **Characteristics:**
    - It is a vast, treeless biome underlain by permafrost, encircling the Arctic Ocean and extending south to the coniferous forests of the taiga.
    - Low biodiversity due to harsh conditions, with plant life dominated by low-growing shrubs, grasses, mosses, and lichens.
    - Wildlife includes Arctic foxes, polar bears, reindeer, musk oxen, lemmings, and wolves.
3. **Climate:**
    - Winters are long and bitterly cold, with average temperatures below -30°C (-22°F).
    - Summers are short and cool, with average temperatures ranging from 3°C to 12°C (37°F to 54°F).

Significance for GS3 (Environment & Climate Change):

1. **Climate Feedback Mechanisms:**
    - Arctic emissions amplify global warming through positive feedback loops, making it a critical area of study for climate change mitigation.

2. **Global Impacts:**
    - Methane is a potent greenhouse gas, with a global warming potential significantly higher than CO2 over a 20-year period.
    - Changes in the Arctic Tundra have cascading effects on global weather patterns, sea levels, and biodiversity.
3. **Policy Implications:**
    - The findings underscore the need for global cooperation in mitigating Arctic warming through measures such as:
        - Reducing greenhouse gas emissions.
        - Monitoring and regulating human activities in the Arctic.
        - Enhancing research on Arctic ecosystems.

Way Forward:

1. **Strengthening International Collaboration:**
    - Enhance cooperation under frameworks like the Arctic Council and the Paris Agreement to address Arctic-specific climate challenges.
2. **Investment in Research:**
    - Increase funding for studying permafrost dynamics, feedback loops, and mitigation strategies.
3. **Sustainable Development Practices:**
    - Implement strict environmental regulations for infrastructure and resource extraction projects in the Arctic.
4. **Promoting Awareness:**
    - Highlight the role of the Arctic in global climate systems to garner public and political support for action.

7. Santa Ana Winds

Santa Ana winds are significantly increasing the risk of wildfires and cause damage across affected regions of California.

Santa Ana Winds

Significance: Santa Ana winds significantly increase the risk of wildfires and cause widespread damage across affected regions of California.

Key Features of Santa Ana Winds

1. **Definition:**
    - Santa Ana Winds are strong, extremely dry, and hot downslope winds that affect coastal Southern California and northern Baja California.
    - They are comparable to other downslope winds such as **Foehn Winds** (Alps) and **Chinook Winds** (Rocky Mountains, North America).
2. **Seasonality:**
    - Occur primarily during **fall** and **winter** months.
3. **Origin and Movement:**
    - **High-Pressure System:** Originates from high-pressure air masses over the **Great Basin**, a desert region in the western United States.
    - **Downslope Movement:** The air moves from higher elevations (e.g., San Gabriel and San Bernardino Mountains) toward lower coastal regions.
4. **Compression and Heating:**

- As the air descends, it undergoes **compression** and **heating**, resulting in **warm** and **dry** conditions.

5. **Key Characteristics:**
    - **Strong Gusts:** Wind speeds often range from **30-50 mph**, with gusts exceeding **70 mph**.
    - **Low Humidity:** Humidity levels drop below **10%**, increasing fire danger significantly.
6. **Impact:**
    - Intensifies wildfire risks due to **extremely dry air**, high wind speeds, and warm temperatures.
    - Example: The **2017 Thomas Fire**, one of California's largest wildfires, was exacerbated by Santa Ana Winds.

GS Relevance

Prelims Perspective:

- **Geography:** Understand the concept of downslope winds and their impact on local weather conditions (linkage to similar winds such as Foehn and Chinook).
- **Environment:** Role of winds in exacerbating wildfires and ecological consequences.

Mains Perspective:

- **GS Paper I (Geography):**
    - Mechanisms of wind systems and regional climate variations.
    - Role of geographic features like the Great Basin and coastal mountains in modifying wind patterns.

- **GS Paper III (Disaster Management):**
    - Impact of climatic and environmental factors on wildfire hazards.
    - Case studies on disaster-prone regions and preparedness (e.g., California).

8. COASTAL HARDENING

Definition:

Coastal hardening involves the construction of physical structures such as **seawalls, harbors, roads, highways, railway revetments**, and **urban infrastructure** to protect coastlines from **erosion** and **flooding**. These are primarily built using materials like **concrete, rocks, and steel**.

Impacts of Coastal Hardening

1. Impact on Ecosystems:

- **Habitat Disruption:**
    - Coastal hardening damages or destroys natural habitats such as **wetlands**, **mangroves**, **coral reefs**, and **beaches**.
    - **Example:** Construction of seawalls along parts of the Gulf of Mexico has resulted in the loss of critical mangrove ecosystems.

2. Alteration of Coastal Dynamics:

- Hardening modifies **wave patterns, currents**, and **sediment transport**, often intensifying **erosion** in adjacent areas.
    - **Example:** In the Netherlands, hardening one section of the coast has led to increased erosion downstream along the coastline.

Relevance to India's Coastal Zone Management

1. Importance of Coastal Management:

- With over **7,500 km of coastline**, coastal management is crucial for India to address challenges like **rising sea levels**, **coastal erosion**, and **unregulated development**.
- **Coastal Regulation Zone (CRZ) Act:**
    - Aims to balance **development** with **environmental protection** of India's coastal areas.
    - **Example:** Chilika Lake (Odisha), under threat from coastal hardening, has been preserved through CRZ regulations, ensuring its biodiversity remains intact.

2. Use of Sustainable Solutions:

- **Living Shorelines:**
    - These combine **vegetation**, **sand**, and **natural barriers** for ecologically friendly coastal protection.
    - **Example:** Restoration of mangroves and natural buffers in Sundarbans and Tamil Nadu.

Adaptation to Climate Change

1. Increasing Vulnerability:

- Rising **sea levels** and **extreme weather events** due to climate change have made cities like **Mumbai**, **Chennai**, and **Kolkata** more vulnerable to coastal flooding.

2. Hard and Soft Solutions:

- While coastal hardening provides **temporary protection**, long-term strategies must focus on **sustainability**.

- **Example:** The **Mumbai Coastal Road Project** incorporates seawalls along with **mangrove restoration** to balance hard and soft engineering solutions.

3. National Adaptation Initiatives:

- **National Adaptation Fund for Climate Change (NAFCC):**
  - Supports coastal resilience projects like **coastal afforestation**, **flood defense systems**, and **ecosystem-based adaptation measures**.

GS Relevance:

Prelims:

- Geography: Types of coastal protection (e.g., seawalls, living shorelines).
- Environment: Impact of human interventions like hardening on ecosystems (e.g., mangroves, coral reefs).
- Policies: Coastal Regulation Zone (CRZ) Act, NAFCC.

Mains:

- **GS Paper I (Geography):**
  - Coastal erosion and its mitigation.
  - Case studies: Sundarbans, Chilika Lake.
- **GS Paper III (Environment & Disaster Management):**
  - Impact of climate change on coastal areas.
  - Integration of sustainable and adaptive solutions for disaster resilience.

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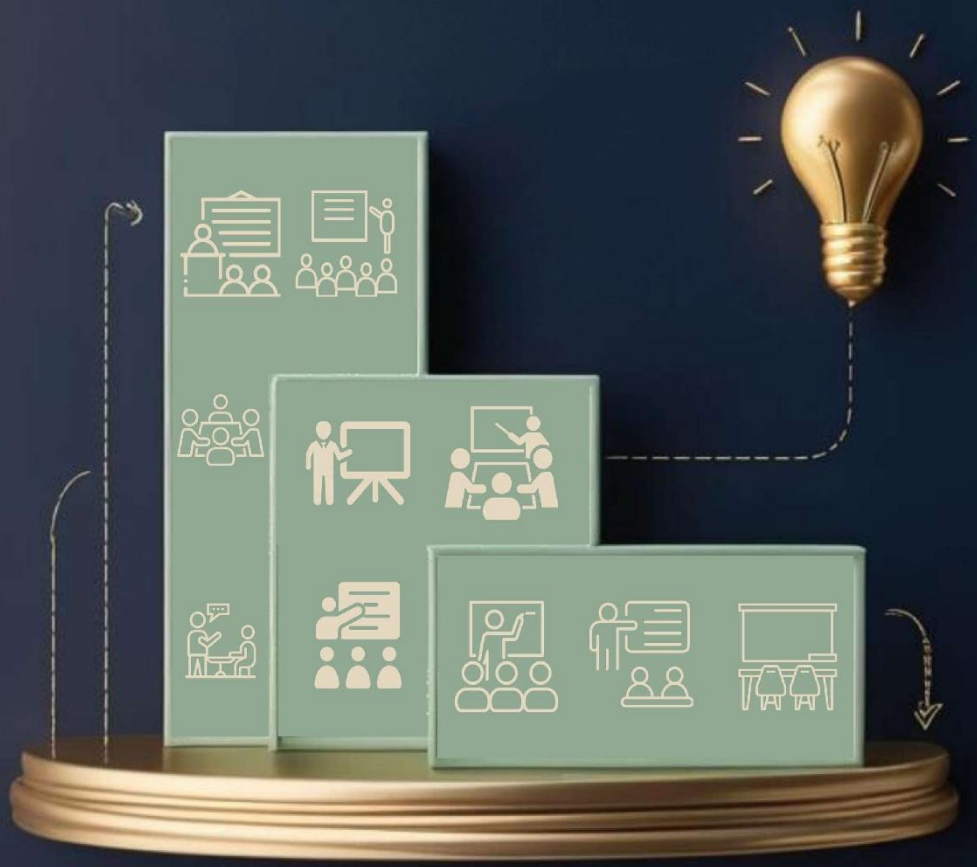

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9. Exercise Surya Kiran

- **Type:** Annual Joint Military Exercise
- **Participating Nations:** India and Nepal
- **Location:** Nepal Army Battle School, Saljhandi (Shivalik ranges, Western Nepal)
- **Current Edition:** 18th Edition
- **Objective:**
    - Enhance mutual cooperation and interoperability between the armed forces of India and Nepal.
    - Focus on counter-terrorism operations and jungle warfare in mountainous terrain.

Key Features:

1. **Training Aspects:**
    - Jungle warfare techniques.
    - Simulation-based counter-terrorism operations.
    - Capacity-building for joint disaster response.
2. **Humanitarian Assistance:**
    - Emphasis on disaster management and humanitarian relief during emergencies.

Significance:

- Strengthens defense ties and bilateral relations between India and Nepal.

10. **Fighter Jet Generations**

Unverified images of what is being termed as a Chinese sixth-generation fighter aircraft have gone viral on social media.

- **About Generation in Fighter Jet:**
- The concept of "generations" in fighter jets classifies them **based on technological advancements and the era of development.** Each generation reflects significant innovations in speed, stealth, avionics, and weaponry, shaping the future of aerial warfare.

The Indian Air Force (IAF) operates a diverse fleet of fighter aircraft across different generations

2nd Generation Fighter Aircrafts

- **MiG-21 Bison**: Although being phased out, it is still in limited service.

3rd Generation Fighter Aircrafts

- **MiG-29 UPG**: Upgraded versions of the MiG-29.
- **SEPECAT Jaguar**: Used for ground attack and maritime strike roles.

4th Generation Fighter Aircrafts

- **Dassault Rafale**: A multirole fighter aircraft.
- **HAL Tejas**: A light combat aircraft developed by India.
- **Mirage 2000**: A multirole fighter aircraft.
- **Sukhoi Su-30MKI**: A twin-jet multirole fighter aircraft.

Generation	**Era**	**Key Features**
1st Gen	**1943-1955**	**Subsonic speeds, basic avionics, unguided weapons, straight or swept wings.**
2nd Gen	**1955-1970**	**Supersonic speeds, afterburners, radar systems, and semi-active guided missiles.**
3rd Gen	**1960-1970**	**Multi-role capabilities, beyond-visual-range combat, integrated airframes, advanced radars.**
4th Gen	**1970-2000s**	**Multi-role fighters, fly-by-wire control systems, heads-up displays, initial stealth features.**
5th Gen	**2000 onwards**	**Stealth design, advanced avionics, network-centric warfare, data fusion, supersonic sustained speeds.**

- **Nations with 5th Generation Fighters:**
- **United States:** F-22 Raptor, F-35 Lightning II.
- **Russia:** Sukhoi Su-57.
- **China:** Chengdu J-20.
- **India (Developing):** AMCA (Advanced Medium Combat Aircraft)
- Contributes to regional security and disaster preparedness.

11. National Sports Awards

Recently, the union Ministry of Youth Affairs & Sports announced the National Sports Awards 2024.

About National Sports Awards:

- National Sports Awards are given every year to recognize and **reward excellence in sports.**
- **'Major Dhyan Chand Khel Ratna Award'**
    - It is given for the spectacular and most outstanding performance in the field of sports by a sportsperson over the period of the **previous four years.**
- **Arjuna Award**:
    - It is given for outstanding performance in Sports and Games' is given for good performance over a **period of the previous four years** and for showing qualities of leadership, sportsmanship and a sense of discipline.
- **Arjuna Award (Lifetime)**
    - It is given to honour and motivate those sportspersons who have contributed to sports by their performance and continue to contribute to promotion of sports even after their retirement from active sporting career.
- **'Dronacharya Award**
    - **It is given** for **outstanding coaches in Sports and Games'** is given to coaches for doing outstanding and meritorious work on a consistent basis and for enabling sportspersons to excel in International events.
- **Maulana Abul Kalam Azad (MAKA) Trophy:** It is awarded forthe overall top performing university in Khelo India University Games.

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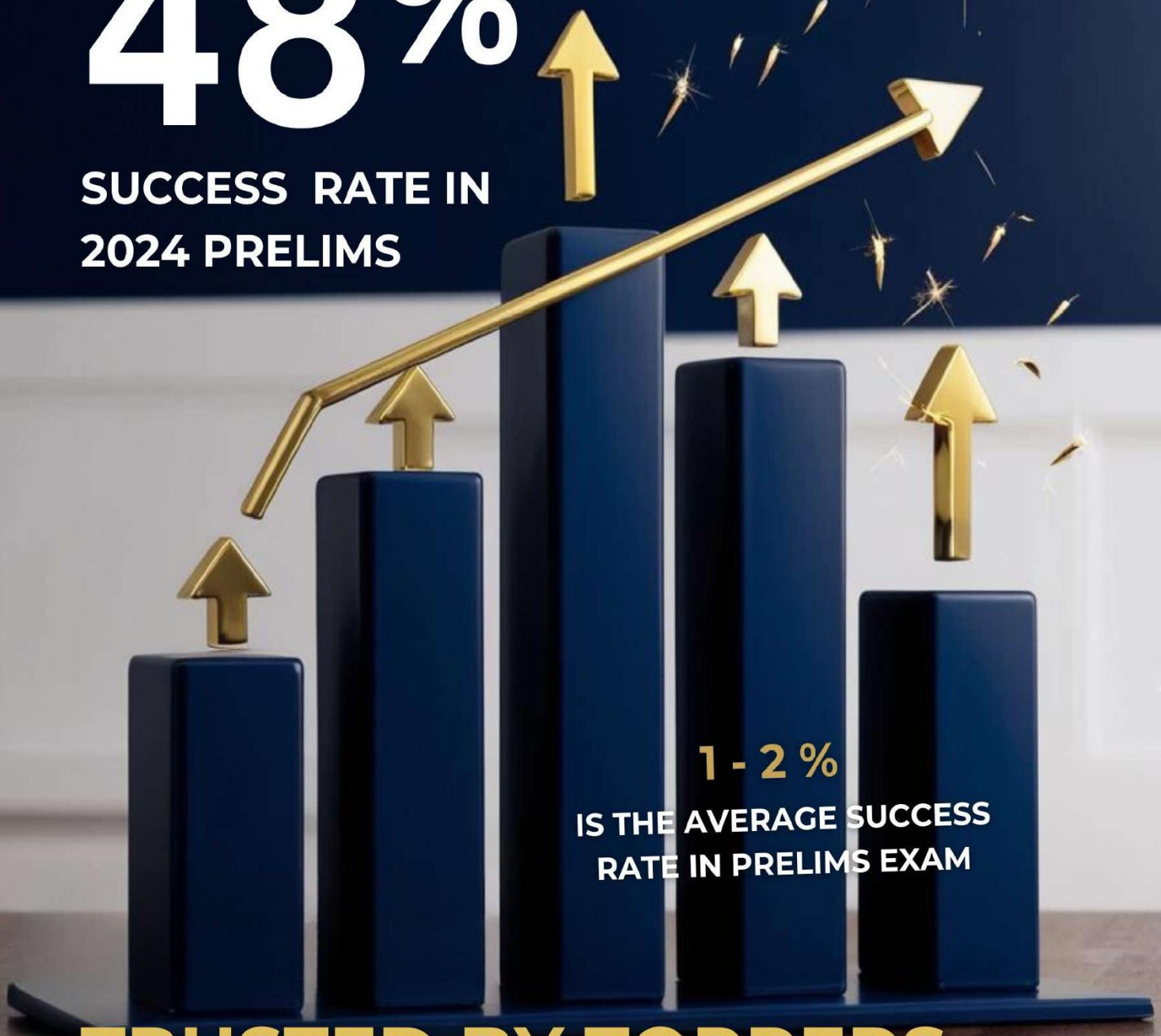

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12. Formation of the Ramesh Chand Panel to Revise WPI Base Year and Transition to PPI

The Government of India has constituted an 18-member panel under the leadership of Ramesh Chand, a member of NITI Aayog, to revise the base year of the Wholesale Price Index (WPI) and propose a roadmap for transitioning to the Producer Price Index (PPI). This initiative underscores the government's commitment to modernizing economic indicators to reflect structural changes in the economy and align with global best practices.

Mandate of the Panel: The Ramesh Chand panel has been tasked with the following key objectives:

1. **Revision of the Base Year:** Revise the base year of the WPI from 2011-12 to 2022-23 to ensure the index remains relevant and reflective of current economic realities.
2. **Propose Revised Commodity Baskets:** Develop revised commodity baskets for both WPI and PPI, considering significant structural changes in the economy, such as the growing contribution of services and changes in consumption patterns.
3. **Review and Recommend Improvements in Price Collection:** Analyze the current methodology for price collection and suggest reforms to enhance accuracy and efficiency.
4. **Decide Computational Methodologies:** Recommend appropriate computational methodologies for both WPI and PPI to ensure robustness and alignment with international standards.
5. **Composition of the Panel:** The panel includes economists from government institutions, representatives from rating agencies, asset management companies, banks, the Reserve Bank of India (RBI), and

government officials. This diverse representation ensures a comprehensive approach to the revision process.

6. **Timeline for Submission:** The panel has been directed to submit its final report to the Office of the Economic Adviser at the Department for Promotion of Industry and Internal Trade (DPIIT) within 18 months.

Wholesale Price Index (WPI) vs. Producer Price Index (PPI):
Understanding the differences between WPI and PPI is crucial to evaluating the need for this transition.

1. **Definition and Scope:**
    - **WPI:** Reflects the price of goods at the wholesale level, i.e., goods traded in bulk between organizations. It does not capture inflation experienced by consumers, as they purchase goods at retail prices.
    - **PPI:** Measures price changes from the producers' perspective and includes both goods and services. It tracks price changes at various stages of production.
2. **Exclusion of Services:**
    - WPI excludes services, which contribute to approximately 55% of India's GDP, making it less representative of the overall economy.
    - PPI includes services, offering a more comprehensive measure of inflation.
3. **Methodological Differences:**
    - **WPI:** Weighting of items is based on net traded value, leading to potential biases like double counting and exclusion of exports and imports.

- **PPI:** Weights are derived from Supply Use Tables, reducing biases and ensuring alignment with the internationally agreed System of National Accounts (SNA).

4. **Tax and Consumer Perspective:**
    - WPI includes indirect taxes, which can distort price changes.
    - PPI excludes indirect taxes, focusing solely on the prices received by producers.
5. **Global Practices:**
    - Most countries have replaced WPI with PPI as it provides a more accurate and internationally comparable measure of economic activity and inflation.

Analysis and Way Forward:

1. **Importance of Revising the WPI Base Year:** The economy undergoes significant structural changes over time, including shifts in production patterns, the emergence of new industries, and technological advancements. Revising the base year ensures the index remains relevant, accurately reflecting these changes.
2. **Transition to PPI:**
    - Transitioning to PPI will align India with global practices and provide policymakers with a more nuanced understanding of inflationary trends.
    - Inclusion of services in PPI will capture a significant portion of the economy currently omitted by WPI, making the index more comprehensive.

3. **Challenges in Implementation:**
    - The transition requires substantial changes in data collection mechanisms and computational methodologies.
    - Coordination between various stakeholders, including industry representatives and government agencies, will be critical.
4. **Recommendations:**
    - Ensure robust capacity building for data collection agencies to adopt new methodologies.
    - Conduct extensive stakeholder consultations to finalize commodity and service baskets for PPI.
    - Launch pilot studies to test the proposed methodologies before full-scale implementation.
    - Enhance public awareness about the significance of PPI and its implications for economic policymaking.

Conclusion: The establishment of the Ramesh Chand panel marks a pivotal step toward modernizing India's inflation measurement framework. By revising the WPI base year and transitioning to PPI, the government aims to enhance the accuracy and relevance of inflation indices, providing valuable insights for policymakers, businesses, and researchers.

13. Nanopore Technology and its Applications

Overview: Nanopore technology represents a significant advancement in humanity's arsenal against diseases, offering groundbreaking capabilities for molecular detection and sequencing.

What is Nanopore Technology? Nanopore technology involves the use of nano-scale pores embedded in a thin membrane to detect changes in electrical potential as charged biological molecules pass through the nanopores. This technology is capable of sensing and analyzing single molecules, including amino acids, DNA, RNA, and other biomolecules.

Key Features and Advantages:

1. **Single-Molecule Detection:** Nanopore technology can identify individual molecules, making it highly sensitive and accurate.
2. **DNA and RNA Sequencing:** It enables cutting-edge sequencing of DNA and RNA by detecting alterations in electrical conductivity when molecules traverse a nanopore.
3. **Cost-Effective and User-Friendly:** Unlike conventional sequencing methods, nanopore-based sequencing is more affordable, easy to use, and requires minimal computational and laboratory infrastructure.
4. **Low Sample Requirements:** It can analyze samples with small amounts of DNA or RNA, making it suitable for various real-world scenarios.
5. **Real-Time Analysis:** This is the only sequencing technology that provides real-time data analysis in scalable formats, ranging from portable devices to large-scale population studies.
6. **Versatility in Fragment Lengths:** Nanopore technology can sequence native DNA or RNA fragments of any length, from short to ultra-long reads, providing flexibility in genomic analysis.

7. **Targeted Sequencing:** The technology allows focused analysis on specific genes or genomic regions, enabling precise diagnostics and research.

Applications of Nanopore Technology:

- **Healthcare and Diagnostics:** Early disease detection, monitoring genetic disorders, and identifying pathogens.
- **Agriculture and Food Safety:** Detecting genetic modifications, identifying crop diseases, and ensuring food authenticity.
- **Environmental Monitoring:** Analyzing microbial diversity, detecting pollutants, and monitoring ecological changes.
- **Forensics:** DNA fingerprinting and crime scene investigations.
- **Scientific Research:** Enabling breakthroughs in genomics, transcriptomics, and epigenetics.

What is Nanotechnology? Nanotechnology is the study and manipulation of matter at dimensions ranging from 1 to 100 nanometers. At this scale, unique physical, chemical, and biological phenomena emerge, enabling innovative applications across various fields, including medicine, electronics, materials science, and environmental science.

Conclusion: Nanopore technology exemplifies the transformative potential of nanotechnology in addressing critical challenges in health, agriculture, and environmental management. Its scalability, cost-effectiveness, and ability to provide real-time, high-resolution molecular data make it a vital tool in advancing science and improving quality of life.

14. Detection of High-Energy Neutrinos: KM3NeT Project and IceCube Neutrino Observatory

Overview Scientists are deploying two advanced telescopes as part of the Cubic Kilometre Neutrino Telescope (KM3NeT) to detect high-energy neutrinos, often referred to as "ghost particles," beneath the Mediterranean Sea. This initiative marks a significant milestone in neutrino astronomy and the study of cosmic phenomena.

About the KM3NeT Project The KM3NeT project is a cutting-edge research infrastructure designed to house next-generation neutrino telescopes with a detection volume of at least one cubic kilometre. It utilizes Cherenkov radiation—light emitted when neutrinos interact with water or ice molecules—to study neutrino behavior and properties.

Key Features of KM3NeT

1. **Location and Collaboration**
    - KM3NeT is situated in the Mediterranean Sea, with active collaboration among multiple European countries, making it a cornerstone of international scientific cooperation.
2. **Scientific Goals**
    - To explore high-energy neutrinos originating from cosmic events such as supernovae, gamma-ray bursts, and colliding stars.
    - To investigate the properties of neutrinos, including their mass and oscillation characteristics.

Key Components of KM3NeT

1. **ARCA (Astroparticle Research with Cosmics in the Abyss)**
    - **Location:** Offshore Sicily, Italy.
    - **Purpose:** Focuses on detecting high-energy neutrinos from distant astrophysical sources like supernovae and gamma-ray bursts.
2. **ORCA (Oscillation Research with Cosmics in the Abyss)**
    - **Location:** Offshore France.
    - **Purpose:** Specializes in studying neutrino properties by analyzing neutrinos generated in the Earth's atmosphere.

Technological Innovation

- KM3NeT telescopes are equipped with arrays of thousands of optical sensors to detect faint Cherenkov light produced by charged particles resulting from neutrino interactions with the Earth's environment.
- These telescopes are comparable to the IceCube Neutrino Observatory but are located in the deep waters of the Mediterranean Sea, as opposed to being embedded in Antarctic ice.

About the IceCube Neutrino Observatory

1. **Location and Structure**
    - Situated at the Earth's South Pole, the IceCube Neutrino Observatory is a unique facility designed to detect subatomic particles called neutrinos.
    - Managed by the IceCube Collaboration, it involves around 350 physicists from 58 institutions across 14 countries, led by the University of Wisconsin–Madison.
2. **Scientific Contributions**

    - IceCube investigates fundamental questions in physics, including the nature of dark matter and the intrinsic properties of neutrinos.
    - The observatory has successfully detected high-energy neutrinos originating from deep space, providing crucial insights into cosmic phenomena.

Comparison Between KM3NeT and IceCube

- While IceCube operates under frozen Antarctic ice, KM3NeT functions in the deep waters of the Mediterranean Sea.
- Both observatories employ advanced optical sensors to detect Cherenkov radiation, but their differing locations provide complementary data on neutrino interactions and cosmic sources.

Conclusion The KM3NeT project, alongside the IceCube Neutrino Observatory, exemplifies progress in neutrino astronomy and high-energy particle detection. These facilities enhance our understanding of the universe, addressing fundamental questions about cosmic events, neutrino behavior, and the nature of dark matter. Their collaborative, international frameworks highlight the global effort in advancing scientific discovery.

15. Alakananda River

- Alaknanda river flowing through the Garhwal region has been identified as ‘most vulnerable to landslide-induced natural dams', according to a recent study conducted by IIT Roorkee researchers in Uttarakhand.
- The Alaknanda River is one of the two main headstreams of the Ganges River, the other being the Bhagirathi River.
- It originates from the meltwaters of the **Satopanth and Bhagirath Kharak glaciers in the Garhwal Himalayas of Uttarakhand.**
- The river is joined by many tributaries in Uttarakhand.
- Five of the tributaries are considered major, and their points of confluence are also worshipped. They are listed below:

- Vishnuprayag: Alaknanda meets Dhauliganga River
- Nandprayag: Alaknanda meets Nandakini River
- Karnaprayag: Alaknanda meets Pindar River
- Rudraprayag: Alaknanda meets Mandakini River
- Devprayag: Alaknanda meets Bhagirathi. This is the most revered confluence, as it is here when the surging water coming from the mountains are finally called the Ganga.

- At the time of formation of Ganga, Alaknanda’s contribution to the flow is much larger than that of Bhagirathi.
- From its source till its union with Bhagirathi, Alaknanda travels for 190 km (approx.).
- Along the banks of the Alaknanda are numerous important pilgrimage sites such as Badrinath, Hemkund Sahib, and Joshimath.
- The Alaknanda River valley is a significant part of the Char Dham Yatra, a pilgrimage circuit that encompasses four sacred sites—Badrinath, Kedarnath, Gangotri, and Yamunotri.

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