Topics of Discussion:

1. **Bridging India's Numeracy Gap**
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3. **HAMMER Precision Weapon System**
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Bridging India's Numeracy Gap

Context: A recent opinion piece highlights India's widening numeracy gap, despite improvements under the NIPUN Bharat Mission.

What is the Numeracy Gap?

- The persistent difference between children's literacy skills (reading) and numeracy skills (math skills like division, place value, operations) at the foundational level.
- ASER 2024: 48.7% of Class 5 students can read fluently, but only 30.7% can solve basic division → ~18% gap.

Trends in India's Literacy–Numeracy Divide:

1. ASER 2024 shows 48.7% of Class 5 students can read a Class 2 text, but only 30.7% can solve a basic division problem — an 18-percentage point gap.
2. ASER 2024 finds more than 50% of Class 8 students cannot perform basic division, showing stagnation and cumulative learning gaps.
3. Post-pandemic surveys (ASER 2022, 2023, 2024) confirm slower recovery in numeracy compared to literacy, especially among rural and low-income students.
4. States like Kerala, Himachal Pradesh, and Punjab show high reading proficiency but continued weaknesses in fractions, decimals, and multi-digit division.
5. NCERT's NAS (2021, 2023) reports national math proficiency below 45%, significantly lower than countries participating in TIMSS and PISA, reflecting systemic challenges.

Reasons for India Lagging in Numeracy:

- Hierarchical nature of Mathematics: Math builds layer by layer; when early concepts like place value or number sense are unclear, students cannot grasp later topics like decimals, fractions or division, causing learning gaps to widen rapidly.
- Syllabus-driven, pace-based teaching: Teachers often follow the textbook calendar rather than students' learning levels, pushing the class ahead even when most learners haven't mastered the basics — leading to cumulative deficits.
- Lack of structured remedial support: Most schools lack systematic catch-up programmes or differentiated instruction, so children who fall behind in early grades continue to lag throughout upper primary.
- Real-life disconnect in math learning: Studies (J-PAL) show children who score well in school tests struggle to apply math in practical settings and vice-versa, highlighting poor transfer of knowledge between classroom and real-life contexts.
- Teacher capacity and pedagogy gaps: Many teachers have limited exposure to activity-based, conceptual numeracy teaching, resulting in rote-led instruction that fails to build deep mathematical understanding.
- COVID-19 learning disruptions: School closures disproportionately affected rural and low-income students, sharply widening pre-existing foundational math gaps and delaying mastery of Class 1–5 competencies.

Impact of Poor Numeracy:

- High failure rates in Maths and Science: Weak foundational numeracy makes algebra, physics, geometry and problem-solving difficult, leading to significantly higher failure rates in these subjects in Class 10 board exams.
- Early adolescent dropout: As concepts become more abstract in Classes 6–9, children with foundational gaps cannot follow classroom teaching, pushing many to exit school before reaching the board exam stage.
- Reduced access to higher education Students who cannot clear Maths in Class 10 or 12 lose eligibility for science streams, technical diplomas, engineering and competitive exams that require quantitative ability.
- Lower employability and financial literacy: Poor numeracy affects everyday skills such as budgeting, measurement, digital payments, and logical reasoning — limiting success in both formal employment and informal livelihoods.
- Long-term economic and productivity loss: A workforce with weak numeracy reduces national productivity, innovation capacity and readiness for a skill-based economy, threatening India's demographic dividend.

Initiatives Taken:

- NIPUN Bharat Mission (2021): National programme for Foundational Literacy & Numeracy for Classes 1–3.

- Teaching at the Right Level (TaRL): Level-based instruction model adopted by several States.
- PARAKH Rashtirya Survekshan: Nationwide assessment to track foundational learning.
- State-level programmes:
    - Karnataka: Kalika Chetarike
    - Uttar Pradesh: Mission Prerna
    - Dadra & Nagar Haveli & Daman & Diu: Extended FLN to upper primary, improving outcomes
- Activity-based learning kits, math manipulatives, digital FLN tools, teacher training modules.

Way Ahead:

- Extend FLN support up to Class 8: Because nearly half of middle-grade students still cannot do basic division, extending foundational interventions beyond Class 3 ensures continuity and prevents learning gaps from widening further in upper primary.
- Introduce FLN+ skills: Strengthening these higher-order numeracy skills is essential since they form the backbone of board-exam math and significantly influence future readiness in science, commerce, and vocational pathways.
- Shift to learning-level–based instruction: Teaching should match students' actual competency levels—not rigid grade syllabi—so that slow learners receive the scaffolding needed to catch up instead of being left behind year after year.
- Strengthen remedial learning, peer learning, and math labs: Dedicated remedial periods, peer tutoring groups, and hands-on math labs can help rebuild foundational concepts through practice, concrete objects, and personalised support.
- Integrate real-life mathematical contexts: Embedding concepts like budgeting, measurement, discounts, and market arithmetic makes math relevant and enables children to transfer classroom learning to real-world situations effectively.
- Improve teacher training in conceptual and activity-based pedagogy: Teachers need continuous professional development to use manipulatives, visual tools, games, and child-centric methods that build conceptual understanding rather than rote procedural skills.

Q. Despite consistent policy efforts, India's foundational literacy and numeracy levels remain a concern. Critically analyze the shortcomings in India's primary education system and suggest reforms based on global best practices.

WhatsApp Governance

Context: Delhi Government is planning to adopt a WhatsApp-based e-governance system and has proposed a study tour to states like Tamil Nadu, Andhra Pradesh and Karnataka to learn best digital governance practices.

About WhatsApp Governance:

- A digital public service platform that allows citizens to apply for services, verify documents, and download certificates directly through WhatsApp.
- It integrates government services with WhatsApp's API and GenAI tools to provide an automated, user-friendly interface.

Key Features:

- Single-window access: Multiple government services available through one WhatsApp number.
- AI-enabled assistance: Chatbot + GenAI for query resolution, document verification, and guided applications.
- No app required: Works on a platform most citizens already use.
- Multi-department integration: Birth/marriage certificates, licences, caste certificates, and more.
- 24×7 accessibility: Eliminates physical visits and reduces bureaucratic delays.

Significance:

- Citizen-centric governance: Brings government to people's phones, improving convenience and inclusivity.
- Improves efficiency: Reduces footfall in offices and speeds up service delivery.
- Supports Digital India goals: Aligns with national focus on DPI, AI-enabled governance, and service automation.
- Scalable model: Can be expanded across departments and replicated by other states.

Relevance for UPSC Syllabus:

- GS-II – Governance
    - E-governance, Digital Public Infrastructure, citizen-centric service delivery, transparency & accountability.
- GS-III – Science & Tech
    - Application of AI, automation, and digital tools in government systems.
    - Use of emerging technologies for improving administrative efficiency.
- GS-IV – Ethics

- Enhances responsiveness, accountability, and equity in service delivery.
- Useful as an example in ethics case studies on improving public trust.

HAMMER Precision Weapon System

Context: Bharat Electronics Limited (BEL) and France's Safran Electronics & Defence have signed a Joint Venture Cooperation Agreement to manufacture the HAMMER precision-guided air-to-ground weapon system in India.

About HAMMER Precision Weapon System:

What it is?

- The HAMMER (Highly Agile Modular Munition Extended Range) is a smart, precision-guided, air-to-ground weapon designed to strike hardened targets with high accuracy from stand-off ranges.

Developed by: Originally developed by Safran (Sagem), France, and now set for joint manufacturing with BEL in India.

Aim: To provide the IAF and Navy with a combat-proven, modular, precision weapon suitable for mountainous warfare, quick deployment, and integration with aircraft like Rafale and Tejas.

Key Features of HAMMER:

- Modular Architecture: Features a guidance kit + range-extension kit that can be fitted onto multiple types of general-purpose bombs, enhancing flexibility across missions.
- High Accuracy Precision Strike: Uses GPS/INS, infrared, and laser-guided options, enabling accurate strikes on bunkers, hardened shelters, airstrips, and enemy infrastructure.
- Extended Stand-Off Range: Can hit targets up to 70 km, enabling aircraft to strike without entering high-risk airspace—crucial for operations in contested zones.
- High Agility & Manoeuvrability: Optimised for mountain warfare (e.g., Ladakh), allowing precision strikes even in complex topography and high-altitude environments.
- Platform Compatibility: Integrated with Rafale, and to be integrated with LCA Tejas, providing flexibility across Air Force and Navy combat platforms.
- Joint Manufacturing & Indigenous Capability: The BEL–Safran JV will achieve 60% localisation, with BEL leading final assembly, testing, and quality assurance, reducing foreign dependence.

Significance:

- Boost to 'Make in India' Defence Manufacturing: Local production strengthens India's self-reliance in advanced, high-precision weapon systems and supports export potential.
- Enhances Air Force Strike Capability: Provides India with a versatile, precision strike weapon capable of neutralising hardened targets — essential for operational readiness against adversaries.
- Faster, Cost-Effective Availability: Indigenous manufacturing avoids delays associated with emergency imports and reduces long-term procurement costs.

Air Quality Monitoring

Subject: Environment

Context: The Supreme Court has sought details on the equipment used in Delhi's air-quality monitoring stations and whether these instruments are suitable for the city's extreme meteorological conditions.

About Air Quality Monitoring:

What it is?

- Air Quality Monitoring is the systematic measurement of pollutants in the atmosphere to assess compliance with national air standards, identify health risks, understand pollution sources, and support regulatory actions.
- In India, it is governed by the National Ambient Air Quality Standards (NAAQS), 2009.

Types of Air-Quality Monitoring Devices:

1. **Continuous Ambient Air Quality Monitoring Stations (CAAQMS):**
    - Automated, temperature-controlled stations used for real-time monitoring.
    - Track eight pollutants: PM2.5, PM10, NO_2, SO_2, CO, O_3, NH_3, and Pb.
    - Used extensively in Delhi (40 stations).
2. **Manual Monitoring Stations (e.g., Gravimetric Samplers):**
    - Measure pollutants using manual collection methods, especially for PM, metals, benzene, and PAHs.
    - Provide periodic data, not real-time information.
3. **Low-Cost Sensors (LCS):**
    - Compact devices useful for trend analysis, public awareness, and dense spatial mapping.
    - Less accurate; require calibration against reference-grade instruments.

How It Works?

- Particulate Matter (PM2.5 & PM10):
    - Measured primarily using Beta Attenuation Monitors (BAM):
    - A beta radiation source passes through clean filter tape.
    - Air is drawn; particles accumulate; beta signal decreases.
    - Reduction in signal = pollutant mass concentration.
    - Used widely in Delhi under CPCB guidelines.
- Sulphur Dioxide (SO_2): Measured by UV fluorescence; SO_2 emits faint fluorescence under UV light.
- Ozone (O_3): Measured by UV photometry, tracking ozone's absorption of ultraviolet light.
- Carbon Monoxide (CO): Measured by Non-Dispersive Infrared (NDIR) absorption, based on CO's absorption of IR waves.
- Nitrogen Oxides (NOx): Measured by chemiluminescence, detecting light produced when NO reacts with ozone.
- Ammonia (NH_3): Measured using optical spectroscopy based on its absorption spectrum.

Key Features of Continuous Monitoring Systems:

- Automated Real-Time Measurement: Provide minute-to-minute readings essential for AQI calculation and forecasting.

- Temperature-Controlled, Dust-Proof Cabins: Ensure instrument stability in diverse environmental conditions.
- Standardised Protocols: Operate under CPCB's 2012 guidelines ensuring uniform calibration, sampling, and quality-control procedures.
- Remote Data Transmission: Data is relayed to CPCB/SPCB servers and displayed publicly on AQI dashboards.
- Multi-Pollutant Capability: Each station tracks eight regulated pollutants simultaneously.

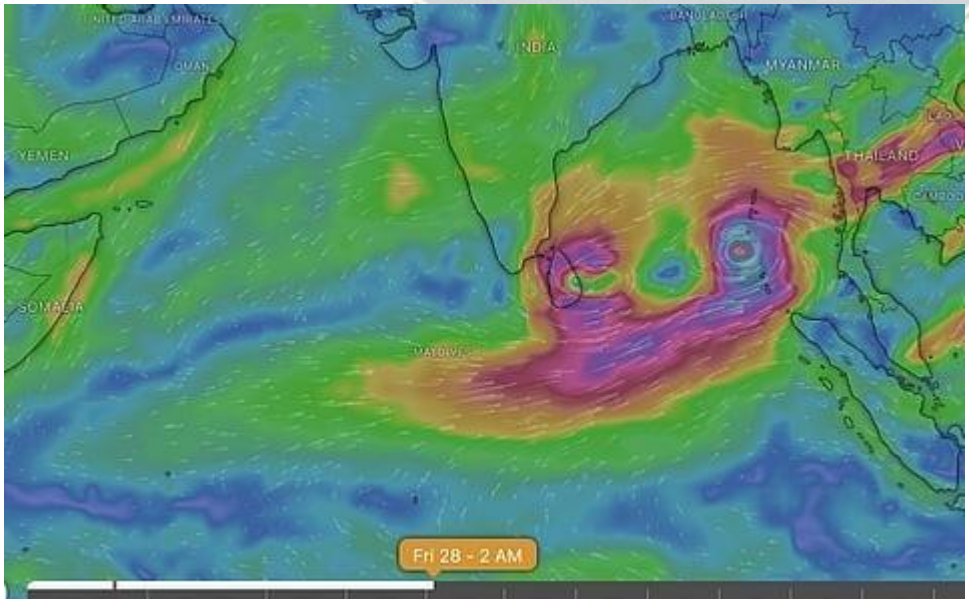
Limitations:

- High Humidity Interference: Beta-gauge monitors overestimate PM levels when relative humidity >60%, as particles absorb moisture and appear heavier.
- Calibration & Instrument Drift: Infrequent calibration leads to instrument drift, impacting accuracy of PM and gaseous pollutant readings.
- Location Constraints: Stations placed near buildings, trees, or vents face distorted airflow, causing skewed readings.
- Data Availability Gaps: CPCB requires 16 hours of valid data/day; many Delhi stations fail due to power outages, equipment failure, and maintenance issues.

Fujiwhara Effect

Subject: Geography

Context: Two potential cyclonic storms are forming in the Bay of Bengal, with global forecast models indicating a possible Fujiwhara interaction between them.



What is the Fujiwhara Effect?

- A rare meteorological phenomenon where two nearby cyclonic systems begin to rotate around a common centre due to interaction of their wind circulations.
- Identified by Sakuhei Fujiwhara (1921), it occurs mostly in the tropical cyclone belt when storms are within ~1,400 km of each other.

Factors Aiding Its Occurrence:

- Proximity of two cyclones within a threshold distance (typically <1400 km in the Indian Ocean).
- Similar rotational direction (counter-clockwise in the Northern Hemisphere).
- Favourable sea surface temperatures >26°C supporting sustained convection.
- Low vertical wind shear allowing stable cyclone structure.

How it forms?

- Close Formation: Two cyclones forming within ~1400 km begin influencing each other's wind fields and natural movement patterns due to proximity.
- Wind Interaction: Their outer rainbands and upper-level winds overlap, creating deformation zones that gradually pull the systems toward each other.
- Coupled Circulation: The interacting winds generate a shared pivot point, forcing both cyclones to rotate in curved, mutually influenced paths.
- Orbiting: If one storm is stronger, the weaker one revolves around it and may eventually be absorbed due to energy imbalance.
- Merger: When centres move very close, the vortices fuse into a single, larger cyclone with enhanced convection and stronger winds.
- Weakening: Competition for heat and moisture can deprive the weaker cyclone of inflow, triggering rapid weakening or dissipation.
- Deflection: If interaction is weak, storms may push each other onto diverging paths, adding significant uncertainty to forecasts.

Key features:

- Mutual Rotation: Both cyclones circle a common centre anti-clockwise, altering their original trajectories and movement speed.
- Energy Transfer: The stronger system can steal momentum or moisture from the weaker one, reshaping their relative strengths.
- Track Uncertainty: Steering winds get disrupted, making prediction of landfall, intensity, and movement highly challenging for meteorological agencies.
- Possible Fusion: Close approach may cause the cyclones to merge into a more intense system with higher rainfall and damaging winds.

- Stalling: Storms may slow down or stall during interaction, prolonging rainfall events and increasing flood risks.

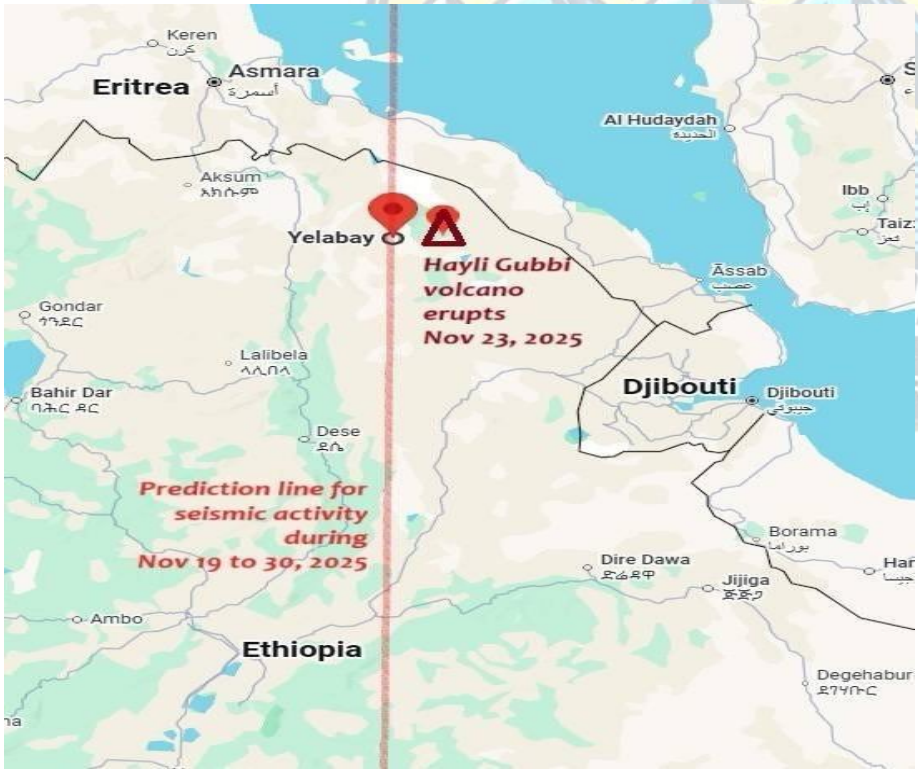
Implications:

- Forecast Challenges: High uncertainty delays accurate warnings for landfall and complicates planning for evacuation and relief operations.
- Heavy Rainfall: Prolonged interaction increases rainfall over TN, Andhra, Odisha, Bengal, Sri Lanka, and Myanmar, worsening flood potential.
- Intensification Risk: Energy transfer or merger can rapidly strengthen one system, raising threats of severe winds, storm surge, and coastal damage.

Hayli Gubbi Volcano

Subject: Geography

Context: A massive volcanic ash cloud from Ethiopia's Hayli Gubbi volcano—which erupted after nearly 10,000 years—has drifted toward India, raising concerns over air quality and aviation.



What it is?

- Hayli Gubbi is a shield volcano in Ethiopia's Afar Region, known for broad, gently sloping volcanic structures formed by low-viscosity basaltic lava typical of the East African Rift system.

Located In: It lies in the Afar Depression of Ethiopia, at the southern end of the Erta Ale volcanic range, one of the most active tectonic and volcanic zones in the world.

History Background:

- No confirmed eruptions for ~10,000–12,000 years (Holocene).
- On 23 November 2025, a sudden sub-plinian eruption produced an ash plume reaching 45,000 ft (FL450).
- The plume drifted across Red Sea, Yemen, Oman, and then moved east toward western India.

Key Features:

- Shield volcano type—broad, low-gradient, large lava fields.
- Part of the divergent plate boundary where the African Plate is rifting.
- Eruption produced volcanic ash, SO_2, glass shards, and rock particles transported at high altitudes (15,000–45,000 ft).
- Classified as sub-plinian due to vertical column height and ash dispersal scale.

Other Major Volcanoes in Africa:

- Mount Nyiragongo (DR Congo) – One of the world's fastest lava flows.
- Mount Silali (Kenya) – Extinct caldera volcano.
- Dabbahu Volcano (Ethiopia) – Rift-related fissure eruptions.
- Mount Alayta (Ethiopia) – Part of Afar Rift.
- Ardoukoba (Djibouti) – Erupted in 1978.
- Mallahle (Ethiopia) – Stratovolcano.
- Asavyo (Ethiopia) – Volcanic field within Afar rift.

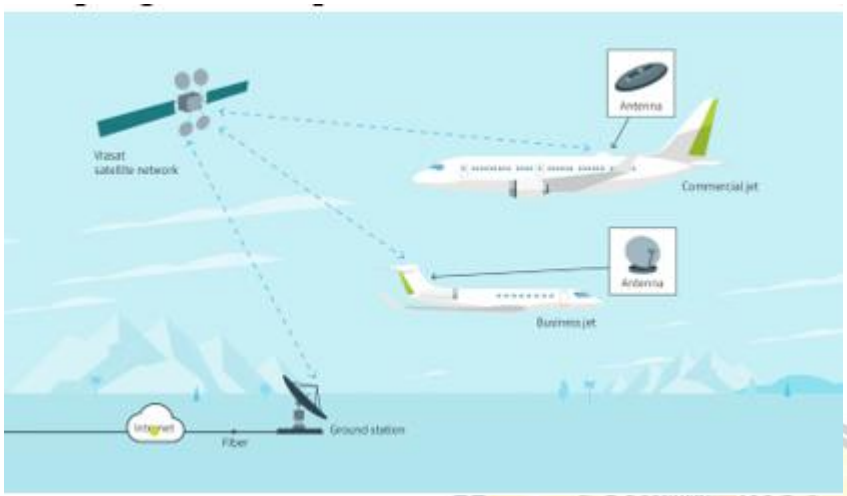
Impact on India:

- Air Quality:
    - Ash is at high altitudes, limiting ground-level mixing; Delhi is unlikely to see major AQI deterioration.
    - Skies may appear hazy/darker but pollutants will remain mostly aloft.
- Health & Climate:
    - SO_2 can contribute to acid rain regionally, but concentrations over India appear limited.
    - Volcanic particles may briefly affect solar radiation and visibility.

In-flight Internet

Subject: Science and Technology

Context: With rising global air travel, in-flight Internet has become a standard service on commercial flights, prompting renewed public interest in how aircraft stay connected mid-air.



About In-flight Internet:

What It Is?

- In-flight Internet refers to wireless Internet access provided to passengers on aircraft, using onboard Wi-Fi networks that relay data to the ground through specialised aviation communication systems.

Types of In-flight Internet Systems:

1. Air-to-Ground (ATG) Systems: Aircraft connect to ground-based towers with upward-facing antennas, similar to cellular networks, making coverage effective over land.
2. Satellite-based Systems: Aircraft use dome-mounted antennas to link with geostationary (GEO) or low-earth orbit (LEO) satellites, enabling connectivity over oceans, deserts, and polar regions.

How it works?

- Your device joins a local wireless network inside the aircraft, which is distributed through multiple ceiling-mounted access points to ensure stable connectivity across the cabin.
- All passenger data flows to a core onboard server that processes requests and directs them either to the air-to-ground antenna or satellite terminal, depending on the system in use.
- The aircraft's antenna maintains a continuous radio link with ground towers or satellites, transmitting packets outward while receiving return traffic for onboard users.
- In satellite-based systems, orbiting GEO or LEO satellites act as intermediaries, bouncing data between the aircraft and ground teleport stations linked to fibre Internet networks.

- Once connected, passengers are routed through a browser login page where the system verifies identity, enforces usage policies, and prioritises limited bandwidth across the aircraft.

Key Features:

- Continuous connectivity even at 30,000+ feet using certified aviation hardware.
- GEO satellites provide wide coverage; LEO constellations offer lower latency and higher speeds.
- Dynamic bandwidth allocation across multiple aircraft.
- Onboard traffic shaping—blocking VoIP calls, compressing images, limiting streaming.
- Multiple Wi-Fi access points ensure cabin-wide signal distribution.

Limitations:

- Bandwidth constraints: Total data is shared by all passengers; speeds drop when many users are active.
- Latency issues: GEO satellites (~36,000 km above Earth) cause delays of 500–700 ms.
- Network variability: Routes, weather, satellite load, and provider quality affect performance.
- High cost: Aircraft antennas, modems, and bandwidth leases are expensive for airlines.

Exercise Suryakiran

Subject: Defence Exercise

Context: India and Nepal will launch the 19th edition of Exercise Suryakiran from November 25 to December 8 in Pithoragarh, Uttarakhand.

About Exercise Suryakiran:

- **What it is?**
    - Exercise Suryakiran is a bilateral, annual, battalion-level military exercise conducted alternately by India and Nepal to enhance defence cooperation, coordination, and military preparedness.
- **Nations Involved:** Indian Army and Nepal Army.
- **Aim:** To improve operational synergy in jungle warfare, counter-terrorism operations, mountain warfare, and integrate modern technologies for improved interoperability and tactical coordination.
- **Features of Exercise Suryakiran:**

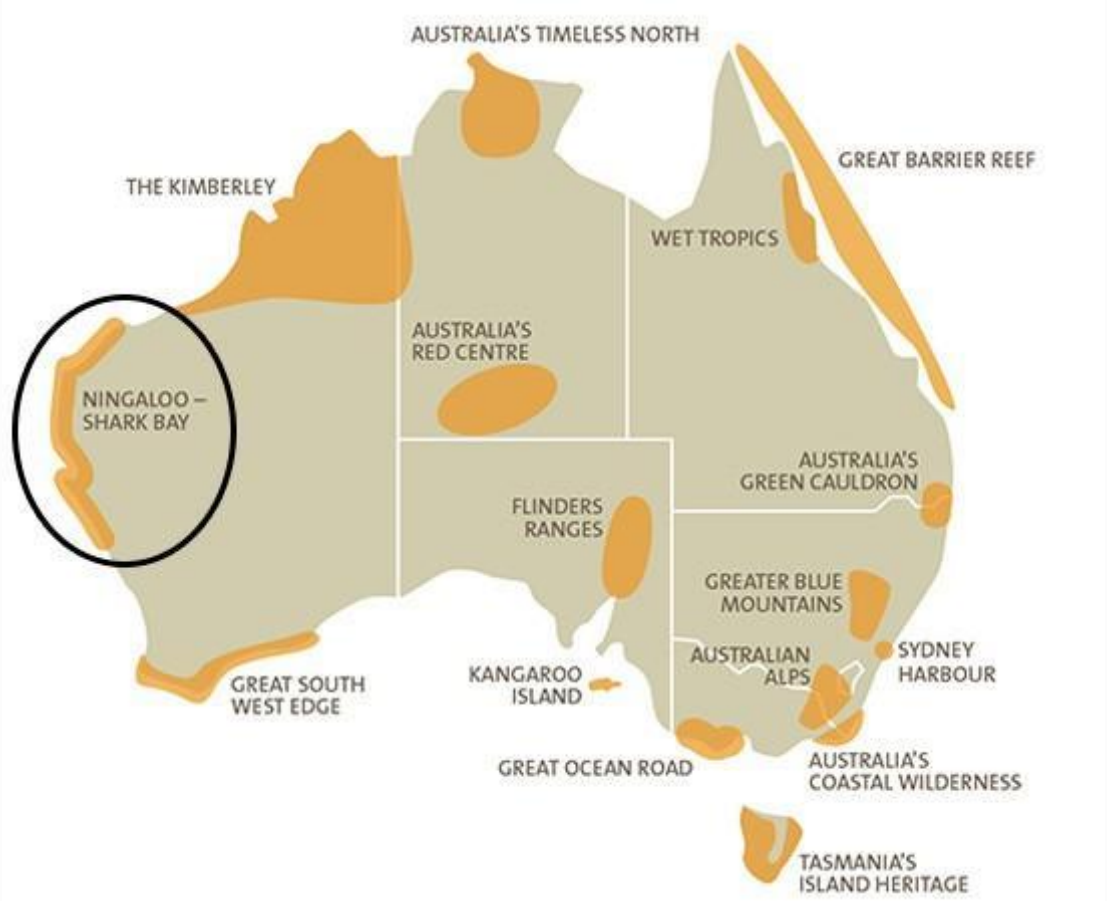
- Joint High-Altitude & Jungle Warfare Drills: The exercise focuses on coordinated operations in forested and mountainous terrain, reflecting the shared geography and operational challenges of both nations.
- Counter-Terrorism Operations: Includes training in cordon-and-search, room intervention, surveillance, and small-team tactics against insurgent and terrorist threats.
- Integration of Niche Technologies: Emphasises the use of modern systems for surveillance, communication, drones, medical evacuation, and battlefield support tools.
- Exchange of Best Practices: Soldiers share combat experiences, tactical knowledge, survival skills, and operational procedures from real-world missions.
- Battalion-Level Participation: Typically involves a full battalion (around 300+ troops) from both sides, including specialists in aviation, medical, engineering, and high-altitude warfare.
- Annual Alternating Format: Exercise is held every year, alternating between India and Nepal; the 18th edition took place in Saljhandi, Nepal (2024–25).

- **Significance:**
  - Reinforces long-standing military ties rooted in mutual trust, respect, and historical kinship between the two armies.
  - Helps standardise operational procedures, communication methods, and tactical responses during joint missions.
  - Contributes to counter-terror preparedness, border security cooperation, and shared responses to emerging threats in the Himalayas.

Ningaloo Reef

Context:

Nearly 70% of corals at UNESCO-listed Ningaloo Reef have died due to Australia's most intense and prolonged marine heatwave ever recorded.



About Ningaloo Reef:

What it is?

- Ningaloo Reef is Australia's largest fringing coral reef and a UNESCO World Heritage Site known for its exceptional marine biodiversity, whale-shark aggregations, and intact coral ecosystems close to land.
- It is one of the world's most significant long, near-shore reef systems.

Located In: Situated along the north-west coast of Western Australia, about 1,200 km north of Perth, the reef stretches across the East Indian Ocean and forms part of the Ningaloo Coast World Heritage Area.

Formation:

- The reef formed through millennia of coral growth along the shallow continental shelf where warm, clear, low-nutrient waters enabled extensive accretion of coral limestone.
- Tectonic uplift of the Cape Range and stable sea levels supported its continuous development.

Key Features:

- 260 km long fringing reef—rare due to its close proximity to the coast.
- UNESCO World Heritage Site (2011), incorporating marine parks, coastal reserves, and the Muiron Islands.
- Home to whale sharks, manta rays, humpback whales, turtles, and diverse coral species.
- Supports ~200,000 tourists annually, significant eco-tourism economy.

- Deep historical connection with Baiyungu and Jinigudira Indigenous peoples, with archaeological evidence dating back 32,000+ years.

Issues:

- Severe marine heatwaves (2024–25): Up to 70% coral mortality, widespread bleaching of dominant species like staghorn corals.
- Rising global sea temperatures: 2023 marine heatwaves lasted 4× longer than average, affecting 96% of world oceans.
- Ecological degradation: Sponges, algae, and invasive organisms now infesting dead coral skeletons, reducing structural stability.
- Previous stress events: Low oxygen levels in 2022 reduced coral cover from 70% to 1% in some sites.

ALSO IN NEWS	
Afghanistan offers 5-year tax break for Indian investors	A commercial attache in India, five-year tax breaks for Indian businesses investing in Afghanistan's gold mining, and an air cargo corridor between India and Afghanistan — these are some of the major takeaways as Taliban-ruled Afghanistan's Commerce and Industry Minister Alhaj Nooruddin Azizi wrapped up his six-day visit on Monday. Interacting with journalists at the Afghan embassy in Delhi on Monday, Azizi said a commercial attache from Afghanistan is expected to arrive in India in a month's time and Kabul wants to boost bilateral trade to "much more" than $1 billion.

How the climate summit COP30 in Brazil shone the spotlight on ‘mutirão’	The 2025 United Nations Climate Change Conference or Conference of the Parties to the UNFCCC, also known as COP30, **concluded Friday in Belem, Brazil**. The summit’s Action Agenda was rooted in *mutirão*, a Brazilian word for collective effort or consensus. The Brazilian presidency of COP30 has described mutirão as a “continuous method of mobilization that begins before, extends through, and continues beyond COP30.”