ASSOCIATION OF SOUTHEAST ASIAN NATIONS (ASEAN)

- **ASEAN** is an **inter-governmental regional organisation** formed to **promote political, economic, and security cooperation** among Southeast Asian nations.
- **Established in 1967** with the signing of the **Bangkok Declaration**, its founding members were **Indonesia, Malaysia, the Philippines, Singapore, and Thailand**.
- **ASEAN currently has 10 member countries**: Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei, Vietnam, Laos, Myanmar, and Cambodia.
- The **headquarters of ASEAN is located in Jakarta, Indonesia**, underscoring Indonesia's central role in the bloc.

Institutional Mechanisms of ASEAN

- The **ASEAN Summit** is held **annually**, where member states discuss regional developments and **set strategic policy directions**. It is chaired by a **rotating presidency**.
- The **ASEAN Coordinating Council (ACC)** monitors the **implementation of agreements and decisions**, ensuring alignment across the member states.
- The **ASEAN Secretariat**, located in Jakarta, acts as the **administrative body** supporting and facilitating ASEAN's initiatives, coordination, and documentation.
- The **ASEAN Regional Forum (ARF)** is a key platform for **dialogue on political and security issues** involving both member countries and external partners.
- **India joined the ARF in 1996**, marking its formal inclusion in ASEAN-led security dialogue mechanisms.
- ASEAN follows a **decision-making process based on consultation and consensus**, promoting unity while respecting national sovereignty.

IN-SPACE

- **IN-SPACe** is a **single-window, independent, autonomous agency** under the **Department of Space (DoS)** created as part of India's **space sector reforms**.
- It aims to **enable, promote, authorise, and supervise** the participation of **Non-Governmental Entities (NGEs)** in various space activities.
- These include the **development of launch vehicles and satellites**, **space-based services**, and the **utilisation or co-development of infrastructure** controlled by **ISRO and DoS**.
- **IN-SPACe** functions as an **interface between ISRO and private players**, helping them access India's space ecosystem and guiding their integration into national goals.
- It also **assesses the requirements of private entities**, educational institutions, and startups to facilitate **research, design, and innovation** in the space sector.
- The **headquarters** of IN-SPACe is located at **Bopal, Ahmedabad**.

Tamil Nadu's Strategic Space Capabilities

- Tamil Nadu already hosts major **ISRO infrastructure**, such as the **ISRO Propulsion Complex (IPRC)** at **Mahendragiri, Tirunelveli**, where **cryogenic and liquid propulsion systems** are tested.
- ISRO is setting up **India's second spaceport** at **Kulasekarapattinam in Thoothukudi**, which will significantly enhance satellite launch capabilities.
- The state is home to **numerous space startups** working in advanced areas like **reusable launch vehicles**, **in-space manufacturing**, **in-orbit refuelling**, and **satellite data analytics**.
- The **Space Technology Incubation Centre (STIC)** at **NIT Trichy** supports southern-region ISRO projects and innovation-led academic collaborations.

WHAT IS THE BHARAT FORECASTING SYSTEM (BFS)?

- It is an **indigenously built advanced weather forecasting system.**
- It was developed by the **Pune-based Indian Institute of Tropical Meteorology (IITM).**
- It will provide **forecasts with a 6 km resolution** — the **highest in the world** — that would allow forecasters to predict small-scale weather features more accurately.
- This resolution is advanced in comparison to the previous 12-km Global Forecast System (GFS) used in India so far.
- This **finer resolution** will **help in more precise predictions of localised weather events** like heavy rainfall and cyclones.
- It is **powered by the Arka supercomputer.** This supercomputer has 11.77 petaflops (a unit to measure computer processing speed) and 33 petabytes (a petabyte is 1,000 terabytes (TB)) of storage.
    - The supercomputer is **located at IITM**, Pune, and will massively **reduce forecasting time compared to the older Pratyush**
- **Data from a network of 40 Doppler Weather Radars** from across the country will be **used to run the BFS** model that would enable the weather office to **issue more localised forecasts as well as nowcasts — weather forecasts for the next two hours.**
    - **Gradually**, the number of **Doppler radars will increase to 100**, which would allow the weather office to issue nowcasts across the country.
- The BFS can **provide 6 km resolution forecasts** for the tropical region that falls **between 30 degrees South and 30 degrees North Latitudes**. The Indian mainland extends between 8.4 degrees north and 37.6 degrees north latitudes.
- Unlike most of the global models, **BFS data** will remain **accessible to researchers worldwide,** fostering collaborative advancements in meteorological science.

IIT BOMBAY'S TANDEM SOLAR CELL BREAKTHROUGH PROMISES CHEAPER AND MORE EFFICIENT SOLAR POWER

- In a landmark development for India's renewable energy landscape, IIT Bombay has unveiled a next-generation solar cell technology that offers a substantial leap in both efficiency and affordability.
- The innovation, developed at the **National Centre for Photovoltaic Research & Education** (NCPRE), employs a tandem structure combining **perovskite and silicon materials to create a solar cell that could significantly boost India's clean energy capacity**.
    - Perovskite materials are a diverse class of compounds, characterized by a specific crystal structure similar to the mineral calcium titanate (CaTiO3).
    - This structure, often represented by the formula ABX3, is responsible for their unique properties and applications in various fields, **particularly in solar cells** and other optoelectronic devices.
- With efficiency rates projected at nearly 30%, compared to the existing 20% in conventional silicon cells, this innovation **may reduce the cost of solar power to as low as ₹1 per kilowatt-hour (kWh)**, making solar energy more accessible and sustainable.

Tandem Solar Cell Technology: A Game-Changer

- The newly developed technology is based on a **four-terminal (4T) tandem solar cell design**.
- In this architecture, a semi-transparent **halide perovskite-based top cell** is layered over a **silicon-based bottom cell**, allowing both to function independently.
    - **Operational Durability:** The tandem cell remains stable under heat and low-light conditions, improving its viability across diverse Indian climates.

- The research team explained that this solution not only improves energy output but also enables better land-use efficiency, which is critical for a densely populated country like India.

Potential Impact on Solar Energy Ecosystem

- **Enhanced Efficiency & Cost Reduction**
  - Boosts power conversion efficiency by **25-30%** over conventional technologies.
  - Expected to bring down the cost of solar electricity to **nearly ₹1 per kWh, a steep drop from the current ₹2.5-4 per unit**.
- **Reduced Import Dependence**
  - Currently, India heavily relies on China for solar-grade raw materials. Perovskite materials, which can be synthesized using locally available chemicals, will help reduce this dependency.
- **Support for Green Hydrogen Initiatives**
  - The Maharashtra government and IIT Bombay are collaborating on a clean energy hub in Uran, with a focus on **green hydrogen** production using this new solar technology.
  - High-efficiency tandem cells are vital for the photoelectrochemical splitting of water to produce hydrogen sustainably.

Strategic Importance for India's Energy Future

- This development aligns with India's long-term goals under the **National Solar Mission** and its **Net Zero 2070**
- As land scarcity and material imports continue to challenge India's renewable energy goals, high-efficiency indigenous solutions like this are critical to scaling up solar energy without proportionate increases in land or capital costs.
- Additionally, the ability to integrate these cells into **rooftops, vehicles (Vehicle-integrated photovoltaics (VIPV)), and buildings (BIPV)** enhances their application versatility, pushing India closer to a decentralized and resilient energy grid.

WHAT ARE ORANS?

- Orans are **traditional sacred groves** found in **Rajasthan**.
- They are **patches of forests dedicated by villagers to different deities** as a socio-religious tradition and **managed by the rural communities.**
- Orans serve as **centers of socio-religious activity** for local communities. Festivals and fairs are held annually, often on specific dates, to honor these sacred places.
- **Rajasthan** is home to about **25,000 'Oran' lands** covering an area of 6 lakh hectares.
- 'Oran' land is **used by local communities for grazing, forest products, natural water filtration,** and for **livelihood opportunities** to promote the livestock economy.
- **Water bodies within the orans**, such as **Talab (pond), Nadi (small pond), open wells,** and streams, are **crucial water resources for livestock and wildlife.**
- **In the Thar Desert, some orans have ancient** goverdhan/shilalekh **(petrograph) near water bodies.**
- The area covered by an oran can range from a **few hectares to several hundred hectares.** For example, the **Bhadariya Mata Oran in Jaisalmer** district spans 17,821 hectares.
- Orans also form the **natural habitat for India's most critically endangered bird, the Great Indian Bustard (GIB)**, a protected species under the Wildlife Protection Act, which is also the State bird of Rajasthan.
- The State's forest policy of 2023 gave the status of general community land to 'Orans', which was considered insufficient for their conservation as well as protection against encroachment and degradation.
- The **Supreme Court recognised 'Oran' lands as forests under the Forest Conservation Act, 1980,** in a landmark judgment delivered on December 18, 2024.

KEOLADEO NATIONAL PARK

- Keoladeo National Park, popularly known as **Bharatpur Bird Sanctuary,** is located in Bharatpur in **Rajasthan**.
- It was founded in the late 19th century as a **hunting preserve by Suraj Mal,** the **maharaja of the Bharatpur** princely state, and became a bird sanctuary in 1956.
- Declared a national park in 1981, it was **renamed Keoladeo for the ancient temple** in the park **dedicated to the Hindu god Shiva.**
- It has an area of 29 sq.km.
- **Woodlands, swamps, and wet grasslands** cover a large part of the park.
- It is a **Ramsar site** and also a **UNESCO World Heritage Site.**
- It is strategically located in the **middle of the Central Asian migratory flyway.**
- It is home to more than 360 species of permanent and migratory birds.
- During the **annual period of migratory visitors** (about October to March), **birds from throughout the world** can be found in the park.
- Among those wintering in the park are **waterfowl from Afghanistan, Turkmenistan,** China, and Siberia, including species **such as gadwalls, shovellers, common teals,** tufted ducks, pintails, white spoonbills, Asian open-billed storks, Oriental ibises, and the rare **Siberian crane.**
- **Vegetation**: The vegetation here is of a **dry deciduous type,** with medium-sized trees and shrubs found inside its forest.
- **Flora**: Some of the trees which can be commonly spotted inside the park are **kadam, jamun, babul, kandi,** ber, kair, and piloo.
- **Fauna**: The park is also home to a range of mammals and reptiles—including **pythons** and other snakes, **deer, sambars, blackbucks,** jackals, monitor lizards, and fishing cat.

OVERFISHING THE THREAT TO OCEAN WEALTH, LIVELIHOODS

- **India's marine fisheries sector**, once increasing source of food and livelihood, **has reached a plateau,** stabilising at three to four million tonnes of annual capture.
- This **indicates that India is operating at the threshold** of its maximum sustainable yield.
- However, beyond this impressive volume lies a story of **inequity, ecological degradation, and policy gaps** that threaten both the marine ecosystem and the millions who depend on it.

Concerns Surrounding India's Fisheries Sector

- **Inequity in the Fisheries Sector**
  - Despite the magnitude of India's marine output, the economic benefits remain unequally distributed. **Small-scale fishers, who constitute 90% of the fishing population, are responsible for only 10% of the catch.**
  - The mechanised fleet, often better equipped and capitalised, dominates the rest.
  - This **imbalance is starkly visible in the socio-economic conditions** of fisher communities, three-quarters of whom live below the poverty line.
- **Environmental Cost of Unsustainable Fishing**
  - India's **multi-species, multi-gear fisheries** present unique management challenges.
  - One glaring issue is the **indiscriminate use of shrimp trawlers,** which extract valuable shrimp while discarding up to ten times their weight in bycatch, mostly juvenile and non-target species.
  - This **practice not only kills large numbers of marine organisms** but also **disrupts marine ecosystems**, damages reef structures, and erodes the long-term productivity of fisheries.
  - Of particular concern is the **widespread use of nets** with mesh sizes under 25mm, which fail to prevent the capture of juvenile fish.

- **Fragmented Regulations and Enforcement Challenges**
    - One major institutional roadblock to sustainable fisheries management in India is the **fragmentation of legal frameworks**.
    - **Each coastal State and Union Territory operates under its own Marine Fisheries Regulation Act (MFRA**), creating a regulatory patchwork that is easily exploited.
    - For instance, f**ish caught illegally or below legal size in one State can be sold in a neighbouring State** with laxer regulations, **undermining conservation efforts**.

The Way Ahead

- **Learning from Global and Local Successes**
    - International models offer valuable insights. **New Zealand's Quota Management System (QMS)**, established in 1986, ties fishing allowances to robust scientific assessments, creating a system that incentivises conservation while allowing for economic activity.
    - **Adapting this model, even on a pilot basis, for India's mechanised trawl fleet could help link fishing quotas** to actual stock health rather than vessel size or fuel consumption.
    - Domestically, success stories also exist. For example, **Kerala's enforcement of a minimum legal size for threadfin bream** led to a 41% increase in catch in a single season.

Conclusion

- India's 11,098 km coastline and over 3,000 fishing villages are increasingly vulnerable to **climate change, coastal erosion, and economic shocks**.
- If overexploitation continues unchecked, the result will be **deepened poverty, irreparable biodiversity loss, and declining yields**.
- However, **the tools for a sustainable future are within reach: science-based quotas, regulatory harmonisation, community stewardship,** and a focus on long-term ecological and economic resilience.