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SUNDAY, 30th NOVEMBER 2025

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1. Metagenomics

- **Prelims** - Metagenomics
- **Mains** - GS 3 - Science and Technology

Why in the news?

- The Rajiv Gandhi Centre for Biotechnology (RGCB) has been chosen as one of the four national next-generation sequencing (NGS) hubs under the Metagenomic Syndromic Surveillance Programme of the National 'One Health Mission'.

Metagenomics

- **What is it?:** Metagenomics is the study of genetic material directly extracted from environmental samples (soil, water, gut, ocean, air, etc.) without culturing organisms.
- **Importance:**
  - ➔ More than 99% of microbes cannot be cultured in the lab- metagenomics helps study them.
  - ➔ Provides a holistic view of microbial diversity, ecosystem function, and metabolic potential.
  - ➔ Useful for-
    - ★ Human health & gut microbiome studies
    - ★ Soil fertility and climate studies
    - ★ Ocean biogeochemistry
    - ★ Disease surveillance
    - ★ Drug discovery
- **Applications:**
  - ➔ **Environment & Ecology:**
    - ★ Mapping soil microbial diversity → soil health indicators.
    - ★ Monitoring methane-cycling microbes → climate change mitigation.
    - ★ Studying marine microbiomes (e.g., Tara Oceans project).
  - ➔ **Health & Disease:**
    - ★ Human gut microbiome → links with obesity, diabetes, mental health.
    - ★ Tracking antibiotic resistance genes (ARGs).
    - ★ Metagenomic sequencing used for pandemic surveillance (SARS-CoV-2 wastewater detection).

➔ **Agriculture:**

- ★ Identifying nitrogen-fixing or phosphate-solubilizing microbes.
- ★ Biofertilizer development.
- ★ Soil metagenome for precision agriculture.

➔ **Biotechnology & Industry:**

- ★ Discovery of new enzymes (lipases, cellulases).
- ★ Bioremediation microbes (oil spills, plastics).
- ★ Industrial fermentation optimization.

2. Entrepreneur-in-Residence (EiR) Programme

- **Prelims -** Entrepreneur-in-Residence (EiR) Programme
- **Mains -** GS 3 - Science and Technology

Why in the news?

- The Union Minister of State for Science & Technology stated that the Entrepreneur-in-Residence (EIR) Programme is becoming increasingly popular among young startups and innovators.

Entrepreneur-in-Residence (EiR) Programme

- **What is it?:**
  - ➔ The Entrepreneur-in-Residence (EiR) Programme is a major component of the National Initiative for Developing and Harnessing Innovations (NIDHI).
  - ➔ NIDHI is implemented by the Department of Science and Technology (DST) under the National Science & Technology Entrepreneurship Development Board (NSTEDB).
- **Objective:**
  - ➔ Support aspiring or budding entrepreneurs in the early stages of their venture.
  - ➔ Provide them time and space to work on their innovative ideas and build a prototype or product.
  - ➔ Create a pipeline of quality startups for the incubators supported by DST.
  - ➔ Reduce the risk of transitioning from an innovator to an entrepreneur, especially for students and youth in science & technology institutions.
- **Key Features:**
  - ➔ **Fellowship support:** Monthly fellowship of ₹10,000 to ₹30,000 for a period of 12–18 months, provided to eligible EiRs through DST-supported Technology Business Incubators (TBIs).
  - ➔ **Focus on Individuals:** It supports individual innovators, not incorporated companies for idea validation, prototype development and market exploration before the formal launch of a startup.
  - ➔ **Infrastructure Access:** EiRs receive access to Incubator facilities, Laboratories and R&D infrastructure, Technical & business mentorship, and Networking and market linkage opportunities.

- ➔ **Structured Pre-Incubation Pathway:** EiR creates a pre-incubation funnel for DST-supported incubators and successful EiRs can be incubated under other DST programmes like NIDHI-PRAYAS, Startup Support, or Seed Support System (SSS).

- **Eligibility Criteria:** EiR applicants must be-
  - ➔ Students, researchers or young innovators with a Science & Technology background.
  - ➔ Have a valid degree or be in the final years of an academic programme.
  - ➔ Not have raised significant external funding for the idea.
  - ➔ Working on a technology-based innovative idea.
- **Sectors and Themes:**
  - ➔ Deep-tech and science-led innovation
  - ➔ Clean energy
  - ➔ Healthcare & medical technologies
  - ➔ Agriculture & rural innovations
  - ➔ Digital technologies
  - ➔ Manufacturing & materials
  - ➔ Biotechnology and environment-related solutions.
- **Significance:**
  - ➔ Promoting science-led entrepreneurship at early stages.
  - ➔ De-risking innovation for students and youth.
  - ➔ Enhancing commercialisation of research in academic institutions.
  - ➔ Supporting DST's vision of developing knowledge-driven and technology-based startups.
  - ➔ Strengthening India's innovation-led economic growth.

3. One Nation One Election

- **Prelims** - One Nation One Election
- **Mains** - GS 2 - Polity

Why in the news?

- The parliamentary committee reviewing the bill on simultaneous Lok Sabha and Assembly elections will request more time to collect additional stakeholder feedback.

One Nation One Election

- **What is it?:**
  - ➔ One Nation, One Election refers to the proposal of conducting simultaneous elections for the Lok Sabha (the lower house of India's Parliament) and all state legislative assemblies.
  - ➔ The idea seeks to synchronize the electoral calendar across India, ensuring elections are held at the same time across the country.
  - ➔ This concept aims to reduce the frequency of elections, thus cutting costs and improving governance efficiency.
- **Historical Background:**
  - ➔ Simultaneous elections were a common practice in India during the first two decades post-independence, with elections to both the Lok Sabha and state assemblies held together in 1952, 1957, 1962, and 1967.
  - ➔ However, the cycle was disrupted due to the premature dissolution of certain state assemblies and the Lok Sabha in the late 1960s and 1970s.
- **Need for One Nation, One Election:**
  - ➔ **Frequent Elections:** Currently, elections are held frequently due to the unsynchronized tenure of the Lok Sabha and state assemblies. This results in multiple elections every year.
  - ➔ **Reduction in Cost:** Simultaneous elections would significantly reduce the overall expenditure on elections, as resources like security personnel, administrative machinery, and logistics would be used more efficiently.
  - ➔ **Minimization of Disruption:** Model Code of Conduct (MCC), which comes into force during elections, restricts government policy-making, leading to Policy Paralysis. This can be avoided with the new system.

- ➔ **Political Stability:** Frequent elections often lead to short-term populist policies, affecting long-term governance. With fewer elections, governments can focus more on governance and development rather than remaining in constant election mode.
- ➔ **Voter Turnout:** Holding simultaneous elections could improve voter turnout as people would only need to vote once in a specific election cycle.

- **Arguments Against One Nation, One Election:**
  - ➔ **Federalism Concerns:** Simultaneous elections might undermine the autonomy of state governments by aligning their tenures with the central government. This could dilute the federal structure of India.
  - ➔ **Logistical Challenges:** Conducting elections across the entire country at the same time would require a huge logistical effort in terms of security, deployment of polling staff, and managing voting infrastructure.
  - ➔ **Premature Dissolution of Assemblies:** If a state assembly or the Lok Sabha is dissolved prematurely, it would disturb the synchronized cycle, raising questions about how to handle such scenarios.
  - ➔ **Voter Behavior:** Simultaneous elections might lead to national issues overshadowing local issues, influencing voter behavior and harming the democratic representation of regional concerns.
- **Government and Legal Position:**
  - ➔ The Law Commission of India and the NITI Aayog have expressed support for the idea, proposing ways to implement it. However, it requires significant constitutional amendments:
  - ➔ **Article 83 and Article 172** deal with the tenures of the Lok Sabha and state legislatures, respectively.
  - ➔ **Article 356** (President's Rule) may also need reconsideration in cases of premature dissolution of assemblies.
  - ➔ A **High level Committee** was set up by the Union government under the chairmanship of former President of India **Shri. Ram Nath Kovind.**
  - ➔ The committee **proposed simultaneous elections for Loksabha, State Assemblies and Local self government institutions** of India

4. Operation Sagar Bandhu

- **Prelims -** Operation Sagar Bandhu
- **Mains -** GS 2 - International Relations

Why in the news?

- In the aftermath of Cyclone Ditwah, India launched Operation Sagar Bandhu to Sri Lanka.

Operation Sagar Bandhu

- **What is it?:**
  - ➔ Operation Sagar Bandhu is a humanitarian assistance and disaster-relief (HADR) mission by the Indian Navy to help a neighbouring country in distress.
  - ➔ The name "Sagar Bandhu" reflects India's maritime outreach: Sagar (sea / ocean), Bandhu (friend/ally), symbolizing solidarity via sea- and air-based support.
- **Key Components:**
  - ➔ **Deployment of Naval & Air Assets**: The first relief consignment was delivered by Indian Navy vessels- INS Vikrant (aircraft-carrier) and INS Udaygiri (warship) — already docked in Colombo, which handed over essential relief materials.
  - ➔ **Airlift of Relief Supplies**: The Indian Air Force (IAF) deployed transport aircraft a C-130J and an IL-76 from Hindon Air Base to Sri Lanka, carrying tonnes of relief material, rescue equipment, and teams.
  - ➔ **Relief Material & Personnel**: Reports mention ~ 21 tonnes of relief goods, including food, hygiene kits, tents, ready-to-eat meals, and rescue equipment; over 80 personnel from National Disaster Response Force (NDRF) were also part of the mission.
  - ➔ **Multimodal HADR Response**: Use of both sea (naval ships) and air (IAF planes) routes to ensure speedy delivery of aid.

- **Significance:**
  - ➔ **Neighbourhood First Policy**: The mission underscores India's "Neighbourhood First" approach toward immediate humanitarian assistance for neighbouring countries.
  - ➔ **Maritime Diplomacy & Regional Leadership**: Through Operation Sagar Bandhu, India reinforces its role as a security and response provider in the Indian Ocean Region, projecting soft-power and maritime-capability solidarity under frameworks like Vision MAHASAGAR.
  - ➔ **Humanitarian & Disaster-Response Capability**: Demonstrates the ability to mobilize naval and air assets quickly for humanitarian needs- an important aspect of India's disaster-response architecture.

5. Samudrayan Project

- **Prelims** - Samudrayan Project
- **Mains** - GS 3 - Science and Technology

Why in the news?

- A crucial set of tests on the Samudrayaan is likely only mid-next year, following a delay in the procurement of syntactic foam cladding from France.

Samudrayan Project

- **Associated Program**: It is part of the Deep Ocean Mission (DOM) launched by the Ministry of Earth Sciences (MoES).
- **Aim**:To send humans to a depth of 6,000 metres in the Central Indian Ocean Basin for deep-sea exploration.
- **Objectives**
  - ➔ To demonstrate India's capability in deep-sea human submersible technology.
  - ➔ To enable exploration and eventual exploitation of deep-sea resources such as polymetallic nodules (cobalt, nickel, manganese, copper).
  - ➔ To support blue economy initiatives and scientific research in marine biodiversity, hydrothermal vents, and oceanography.
  - ➔ To build India's strategic and technological capacity in underwater mining and deep-sea missions.
- **Key Feature: MATSYA-6000**
  - ➔ The manned submersible facilitates the direct observation by the humans in the deep ocean in exploring mineral resources rich in Nickel, Cobalt, rare earth, manganese, and other resources that can be used for scientific analysis.
  - ➔ It will be capable of taking three humans to a depth of 6 km.
- **Significance**
  - ➔ **Scientific**: Enhances understanding of deep-sea ecosystems, climate change studies, and marine biology.
  - ➔ **Economic**: Exploration of polymetallic nodules (estimated 380 million tonnes in India's allocated site by the UN's International Seabed Authority).
  - ➔ **Strategic**: Positions India among a handful of nations (USA, Russia, China, Japan, France) with deep-sea human submersible capacity.
  - ➔ **Technological**: Strengthens indigenous capability in extreme environment engineering.

- **Challenges**
  - ➔ High-risk environment: extreme pressure (600 times atmospheric), low temperature, darkness.
  - ➔ Safety and reliability of indigenous submersible technology.
  - ➔ Environmental concerns of deep-sea mining: biodiversity loss, seabed disturbance.
  - ➔ High cost of development and maintenance.

Deep Ocean Mission

- **Ministry** - Ministry of Earth Sciences
- **Objective** - To explore the deep ocean for resources and develop deep-sea technologies for sustainable use of ocean resources.
- **Six major components of the Deep Ocean Mission:**
  - ➔ Development of technologies for deep-sea mining, and manned submersible
  - ➔ Development of ocean climate change advisory services
  - ➔ Technological innovations for exploration and conservation of deep-sea biodiversity
  - ➔ Deep ocean survey and exploration
  - ➔ Energy and fresh water from the ocean
  - ➔ Advanced marine station for ocean biology.