Balancing Deep-Sea Discovery

Mains: *GSIII – Environment*

Why in News?

India is expanding deep-sea exploration under the Deep Ocean Mission, raising concerns over the ecological risks of commercial seabed mining in poorly understood deep-sea ecosystems.

What is the Status of India's Growing Deep-Sea Footprint?

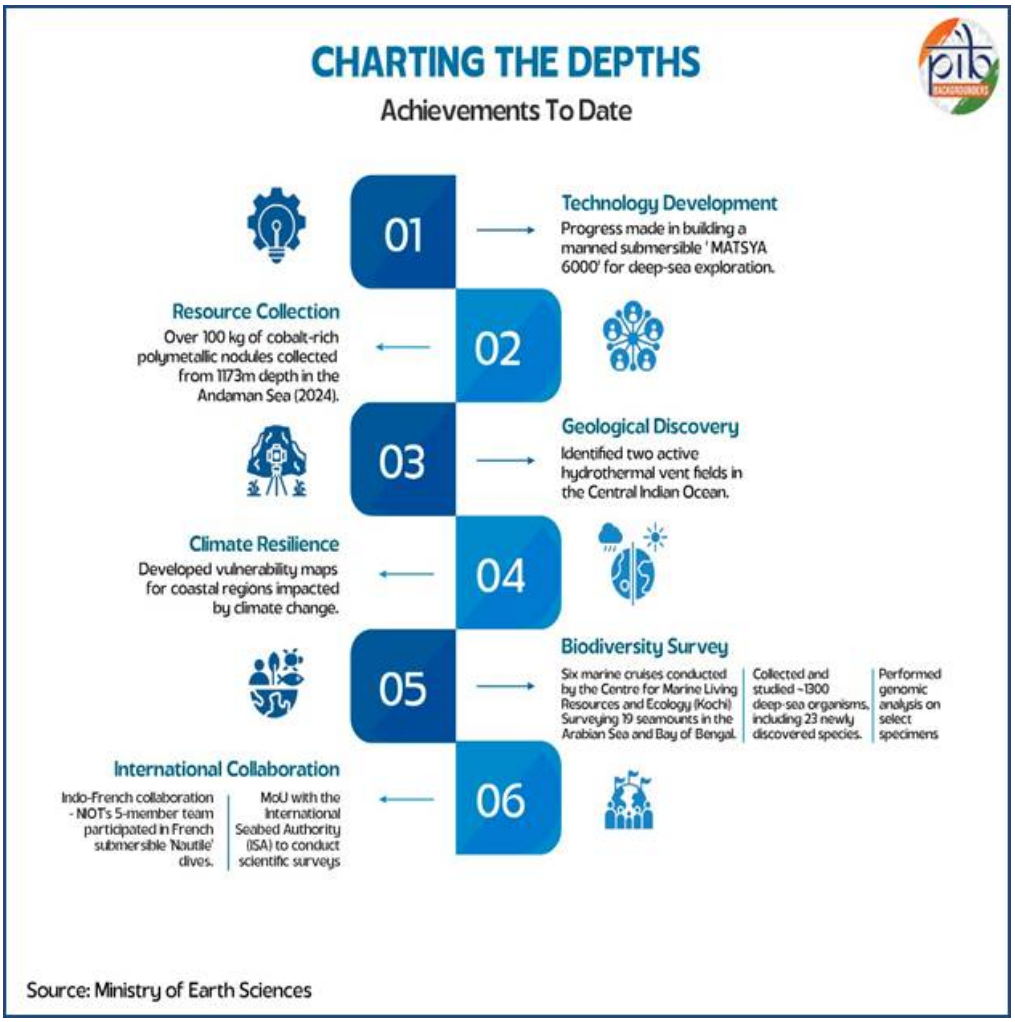
- **Deep sea** – It is the *layer of the ocean starting about 200 meters (660 feet) below the surface* where sunlight begins to fade
- India holds 3 International Seabed Authority (ISA) exploration contracts covering nearly 95,000 sq km.

> *The **International Seabed Authority (ISA)** is an autonomous international organization established under the 1982 United Nations Convention on the Law of the Sea (UNCLOS).*

- These areas include the:
  - Central Indian Ocean Basin
  - Central Indian Ridge
  - Carlsberg Ridge
- **polymetallic nodules** – Exploration has identified around 366 million tonnes of polymetallic nodules containing:
  - Nickel
  - Copper
  - Cobalt
  - Manganese
- Under the Deep Ocean Mission, India is developing:
  - Deep-sea mining technology
  - Underwater robotics
  - MATSYA-6000 human submersible
- The National Institute of Ocean Technology has tested a mining machine at depths of about 5,270 metres.
- **Biodiversity** – Surveys across 19 seamounts have recorded around 1,300 deep-sea organisms, including nearly 23 species reported as new to science.

Why is Deep-Sea Exploration Important for India?

- **Critical Mineral Security** – Polymetallic nodules contain minerals are important for clean-energy technologies, electric mobility and advanced manufacturing.
- **Strategic Autonomy** – Access to critical minerals can reduce India's vulnerability to disruptions in global mineral supply chains and strengthen strategic resource security.



- **Indigenous Technological Capability** – Deep-sea exploration promotes advances in underwater robotics, Submersible technology, Ocean mapping.
- **Scientific Knowledge** – Exploration helps India understand Deep-sea ecosystems, Marine biodiversity, Ocean processes, Climate interactions, Seabed geology.
- **Blue Economy** – Responsible utilisation of marine resources can contribute to India's blue economy, employment, and maritime capabilities.

What are the Major Ecological Concerns?

- **Limited Scientific Understanding** – The deep ocean remains one of the least understood ecosystems on Earth.
    - Discovery of new species indicates that significant biodiversity remains undocumented.
- Hence, large-scale intervention may have consequences that cannot presently be predicted.
- **Destruction of Seabed Habitats** – Mining machines can physically disturb the

seabed and damage habitats supporting deep-sea organisms.

- **Sediment Plumes** – Mining can generate sediment plumes that may spread beyond the mining area and affect organisms in the surrounding water column.
- **Biodiversity Loss** – Slow-growing and highly specialised deep-sea organisms may have limited capacity to recover from large-scale disturbance.
- **Irreversibility and Uncertainty** – Deep-sea ecosystems may take extremely long periods to recover from disturbance.
    - The absence of adequate baseline data makes it difficult to accurately assess long-term impacts.
- **Climate and Ecosystem Functions** – Deep oceans contribute to carbon cycling, nutrient cycling and climate regulation.
    - Disturbance of these ecosystems may have wider ecological implications that are not yet fully understood.

How Can India Balance Development and Conservation?

- **Adopt the Precautionary Principle** – Where scientific knowledge is inadequate and environmental damage may be irreversible.
- **Separate Exploration from Exploitation** – Scientific exploration should continue to improve Biodiversity knowledge, Environmental baselines, Geological understanding.
    - However, exploration should not automatically imply future commercial mining.
- **Establish Environmental Baselines** – Before any extraction, India should establish comprehensive data on Species diversity, Seabed characteristics, and Ecosystem functions.
    - This will enable meaningful environmental impact assessment.
- **Identify Sensitive No-Mining Zones** – Areas containing unique, vulnerable or poorly understood ecosystems should be identified for permanent or long-term protection.
- **Promote Circular Economy** – India should reduce dependence on virgin mineral extraction through
    - Recycling of critical minerals
    - Reuse and repair
    - Material substitution
    - Resource-efficient technologies
    - Sustainable product design to be consistent with the principles of Mission LiFE.
- **Strengthen International Governance** – India should actively participate in the International Seabed Authority and support Science-based regulations, Environmental safeguards.
- **Ensure Continuous Monitoring** – Any future activity should be subject to Baseline assessment, Environmental impact assessment, and adaptive regulation.

What else could be done?

- **Nature-Based Solutions** – Recognise ecosystems as part of the solution to environmental challenges.
- **Sustainable Development Goals** – Balance economic development with environmental protection and intergenerational equity.

- **Circular Economy** – Reduce the dependence of economic growth on continuous extraction of virgin resources.
- **Mission LiFE** – Promote behavioural and consumption changes to reduce resource pressure.

What lies ahead?

- India's Deep Ocean Mission provides an opportunity to develop world-class deep-sea science and technology.
- However, the success of the mission should not be measured merely by how deep India can explore or how much mineral it can extract.
- India can instead demonstrate a model of responsible blue economy, where technological progress is accompanied by ecological restraint.
- The real measure of scientific advancement is not only the ability to exploit a new frontier, but also the wisdom to identify which frontiers should remain untouched.

Reference

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