

Marine and Space Biotechnology: India's Next Strategic Frontier

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Marine and Space Biotechnology Latest News

- Futuristic space and marine biotechnology explores extreme environments such as deep oceans and outer space to generate new biological knowledge, materials, and manufacturing processes.
- Marine biotechnology studies microorganisms, algae, and other marine life to develop bioactive compounds, enzymes, biomaterials, food ingredients, and biostimulants adapted to harsh conditions.
- Space biotechnology focuses on understanding how microbes, plants, and human biological systems respond to microgravity and radiation, expanding possibilities for innovation in science and industry.

Why Marine and Space Biotechnology Matters for India

- India's extensive coastline of over 11,000 km and a vast **Exclusive Economic Zone** of more than **two million sq km** provide access to rich marine biodiversity, yet its global share in marine outputs remains low, revealing large untapped potential.

- Investing in **marine biomanufacturing** can create new sources of food, energy, chemicals, and biomaterials while easing pressure on land, freshwater, and agriculture.
- At the same time, **space biotechnology** is vital for India's long-term space ambitions, supporting safe food production, human health management, and biological manufacturing in extreme environments.
- Together, these fields can position India as a global leader in future-ready biomanufacturing.

India's Current Position in Marine and Space Biotechnology

- India's **marine biomass production**, including seaweed, remains modest at around 70,000 tonnes annually, forcing continued imports of seaweed-derived products like agar, carrageenan, and alginates for food, pharmaceuticals, cosmetics, and medical use.
- Policy initiatives under the Blue Economy agenda, the **Deep Ocean Mission**, and **BioE3** aim to build integrated marine biomanufacturing linking cultivation, extraction, and downstream applications.
- A limited set of private players such as Sea6 Energy and ClimateCrew, alongside research bodies like ICAR-Central Marine Fisheries Research Institute, are exploring scale-up pathways.
- In space biotechnology, Indian Space Research Organisation is advancing microgravity biology research on microbes, algae, and life-support systems, though private-sector participation remains limited due to the sector's nascent stage.

Global Advances in Marine and Space Biotechnology

- The **European Union** is investing heavily in marine bioprospecting, algae-based biomaterials, and bioactive compounds, supported by shared research infrastructure such as the **European Marine Biological Resource Centre**.
- **China** has rapidly scaled seaweed aquaculture and marine bioprocessing to strengthen its bioeconomy.
- In space biotechnology, the **United States** leads through **NASA** and the **International Space Station**, where experiments on microbes, protein crystallisation, stem cells, and life-support systems advance drug discovery, regenerative medicine, and long-duration human space missions.

The Way Forward for Marine and Space Biotechnology

- Marine and space biotechnology remain largely untapped frontiers where early movers can secure long-term strategic and technological advantages.
- The main risk is slow, fragmented research and development.
- A dedicated roadmap with clear timelines and outcomes is essential to focus resources, coordinate efforts, and accelerate progress.

Source: **TH**

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