



UNESCO's State of Ocean Report 2024

For Prelims: [UNESCO](#) State of Ocean Report 2024, [oceanographic research](#), [global warming](#), [acidification](#), [deoxygenation](#), [greenhouse gas emissions](#), [El Nino Southern Oscillation \(ENSO\)](#), [microscopic plankton](#), [Marine heatwaves](#)

For Mains: Key findings of UNESCO's State of Ocean Report, Impacts of the Global Warming on the Indian Ocean

[Source: DTE](#)

Why in News?

Recently, the [UNESCO](#) State of Ocean Report 2024 highlighted the need for enhanced [oceanographic research](#) and [data collection](#) to address escalating ocean crises, including [warming](#), [acidification](#), [deoxygenation](#) and rising sea levels.

What are the Key Findings of the State of Ocean Report 2024?

- **Inadequate Data and Research:** The report identifies a critical gap in data and research on accelerating [ocean warming](#).
 - There is an urgent need for regular data to monitor ocean warming and its impacts, supporting the challenge for healthy and resilient oceans.
- **Ocean Warming:** The upper 2,000 meters of oceans warmed at a rate of about 0.32 Watt/m² from 1960 to 2023, which has accelerated to 0.66 Watt/m² in the past two decades.
 - This warming trend is expected to continue, causing **irreversible changes** over the centennial to millennial timescale.
- **Earth Energy Imbalance (EEI):** Increased [greenhouse gas emissions](#) from human activities has resulted in the increased uptake of the EEI by oceans.
 - **EEI is the balance between incoming energy** from the Sun and **outgoing energy from the Earth**.
 - About **90 % of the EEI** is being **absorbed by oceans**, resulting in a cumulative increase in **ocean heat content (OHC)** in the **upper 2,000 m** of the water column.
 - OHC is the **total amount of heat stored** by oceans.
 - This warming may **prevent ocean layer mixing**, potentially reducing oxygenated deep waters and leading to [deoxygenation](#).
 - Deoxygenation can have **long-term negative impacts** on the health of **coastal and large marine ecosystems** and [coastal communities](#).
- **Ocean Acidification:** There has been a mean global increase in [ocean acidification](#) in all ocean basins and seas.
 - The open ocean has been experiencing a **continuous decline in pH** (increase in acidic levels), with an average global surface ocean pH decline of 0.017-0.027 pH units per decade since the late 1980s.
 - Coastal waters can turn acidic due to **natural processes**, such as freshwater

influx, biological activity, temperature change and climate patterns like [El Nino Southern Oscillation \(ENSO\)](#).

- Human activities like **nutrient input from agricultural and industrial activities also influence** the chemistry of coastal areas.
- However, **limited long-term observations**, particularly in coastal areas, hinder a complete understanding of this phenomenon.
- **Continuation of Sea Level Rise: The global mean sea level from 1993 to 2023 increased at a rate of about 3.4 mm/yr.**
 - The world will have to improve the space-based and in situ observing systems for monitoring sea level rise at global, regional, and coastal scales.
- Marine Carbon Dioxide Removal (mCDR): The report acknowledges the growing interest in mCDR technologies aimed at capturing and [storing atmospheric carbon dioxide](#).
 - **Examples** like **altering the chemical composition of seawater** so that oceans absorb more carbon dioxide from the atmosphere or **adding nutrients such as iron** to encourage the growth of [microscopic plankton](#) that can sink to the seafloor and be stored for centuries or longer.
 - There has been an increased interest in **mCDR technologies** with the growing number of start-ups developing mCDR techniques, alongside **funding** by the United States and the [European Union for mCDR research](#) announced in 2023.
 - There has been some challenges like the **limited use of mCDR** and how they will interact with the **ocean carbon cycle**, possibly causing **unintended consequences** such as threat to marine life in the long term.

What are the Impacts of the Global Warming on the Indian Ocean?

- **Cyclones and Marine Heatwaves: The Indian Ocean is warming faster than other oceans, with the potential for irreversible changes like cyclones and heatwaves.**
 - The [Indian Ocean](#) plays a significant role in the **formation of monsoons and pre-monsoon cyclones** that bring rain and pose threats to South Asia, East Africa, and West Asia.
 - The North Indian Ocean doesn't generate as many cyclones as the Pacific or [Atlantic Ocean](#), but their **numbers and rapid intensification** have been growing making them the deadliest storms by mortality.
 - For example, the 2019 [Cyclone Fani](#) in Odisha, India, caused widespread destruction with its **high winds** and **storm surge**.
 - [Marine heatwaves](#) are becoming more **frequent and intense**, causing [coral bleaching](#) and harming **marine life**.
 - For instance, a **2010 marine heatwave in the Indian Ocean** caused widespread **coral bleaching in the Lakshadweep Islands**.
- **Altered Ocean Circulation and Marine Life: Warming can weaken upwelling, a process that brings cooler, nutrient-rich waters to the surface. This can harm fish populations that depend on these nutrients.**
 - For example, a decline in upwelling in the [Arabian Sea](#) can negatively impact the **sardine fishery**.
 - As the ocean absorbs more carbon dioxide, it becomes more **acidic**, harming **organisms with calcium carbonate shells and skeletons**, such as coral reefs and shellfish.
 - The [Great Barrier Reef in Australia](#) is already experiencing significant damage due to **ocean acidification**, and similar threats are faced by coral reefs in the Indian Ocean.
 - Warmer water holds less oxygen. **Increased stratification** due to warming can prevent deep ocean mixing, leading to **oxygen depletion in deeper layers**. This can create [dead zones](#) where marine life cannot survive.
- **Human Populations at Risk: Disrupted fisheries, cyclones, and droughts all threaten food security for millions of people who depend on the Indian Ocean for their livelihood.**
 - Rising sea levels due to [global warming](#) threaten coastal communities with inundation

and erosion. Low-lying areas in India, such as Mumbai and Kolkata, are particularly vulnerable.

- **Tourism and recreation industries** that rely on healthy coral reefs and beaches will be negatively impacted by bleaching and coastal degradation.

GEO-ENGINEERING



Geoengineering means manipulating the earth's climate to lower its temperature to counter global warming

TYPES OF GEO-ENGINEERING

CARBON DIOXIDE REMOVAL

Technology/ Method Proposed	Proposed Effects/actions	Potential Side Effects	Feasibility/Cost Effectiveness
Land Use Management	Afforestation/ Reforestation	Minimum Side Effects	High feasibility, Low Cost
Bio-energy with carbon capture and storage (BECCS)	Biomass harvested and used as fuel	Potential land use conflict	Comparatively expensive
Direct CO ₂ Capture	Industrial Process	Minimal	High technical feasibility
Fertilization of the ocean	Increased CO ₂ absorption by promoting algae growth	High potential for adverse side effects	Feasible but not cost-effective
Accelerated Weathering	Pulverization of silicate rocks	Potential respiratory health impact	Could be combined with crop production, a feasible option at scale

SOLAR RADIATION MANAGEMENT

Stratospheric aerosol Injection	For reflecting sunlight back into space	Likely impact on the hydrological cycle	Feasible and potentially highly effective
Marine cloud brightening	Seeding of marine clouds with seawater aerosol	Likely impact on precipitation pattern	Low to medium cost and feasible at scale
Giant deflectors in outer space	Mirror placed in near earth orbit	Regional climate effects	Capital-intensive and long gestation
Surface albedo approaches	Painting the roof of the building bright white, Installing desert reflector	Major Impact on Desert Ecosystem	High labor and maintenance cost

REGULATION

- ⌵ No specific international or Indian regulations on geoengineering.

INDIA'S EFFORTS

- ⌵ **Department of Science and Technology:**
 - ◆ Geoengineering climate-modelling research programme (since 2013)

⌵ IISc:

- ◆ Initiative to understand the implications of solar geoengineering for developing countries
- ◆ Scientists simulated injecting 20 million tonnes of sulphate aerosols into the Arctic stratosphere



What are the Steps Taken by India to Mitigate the Effects of Oceanic Heatwaves?

- **Monitoring and Research:**

- [Indian National Centre for Ocean Information Services \(INCOIS\)](#)

▪ **Cyclone Preparedness:**

- [National Disaster Management Authority \(NDMA\)](#)
- [IMD Cyclone Warnings](#)

▪ **Additional Measures:**

- [National Missions on Climate Change](#)
- [Coalition for Disaster Resilient Infrastructure](#)
- [Renewable Energy Target](#)
- [National Hydrogen Mission](#)

Way Forward

- Developing and utilising **real-time weather forecasts** and cyclone warnings to coastal communities.
 - For example, India should aim to enhance the capabilities of the [Indian National Centre for Ocean Information Services \(INCOIS\)](#) for more accurate and timely predictions.
- Several geo-engineering techniques like **stratospheric aerosol injection**, **marine cloud brightening** etc can be utilised on a large scale to tackle the issue of oceanic warming.
- Promotion of **sustainable coastal development** practices building seawalls and levees that minimise damage to infrastructure and communities during extreme weather events.
 - For example, the **Odisha government's initiative to plant casuarina trees** along the coast proved effective in **mitigating the impact of Cyclone Fani**.
- Conducting **public awareness campaigns** and **regular evacuation drills** to educate coastal communities about cyclone risks and evacuation procedures.
- Establishing [marine protected areas](#) to conserve coral reefs and other fragile ecosystems.
- Collaboration of **international efforts to address climate change** and limit global warming will ultimately benefit the Indian Ocean.

Conclusion

Overall, the UNESCO report highlights critical knowledge gaps and the need for improved data collection to understand and address the multiple threats facing oceans across the globe. It also explores potential solutions like mCDR and coastal habitat restoration, emphasising the need for further research to address associated uncertainties.

Drishti Mains Question:

Q. Discuss the status of ocean warming due to climate change and its impacts on the Indian Ocean. Also, suggest the measures need to be taken to mitigate the effects of oceanic warming?

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q.1 Which of the following statements is/are correct about the deposits of 'methane hydrate'? (2019)

1. Global warming might trigger the release of methane gas from these deposits.
2. Large deposits of 'methane hydrate' are found in Arctic Tundra and under the sea floor.
3. Methane in atmosphere oxidizes to carbon dioxide after a decade or two.

Select the correct answer using the code given below.

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

Mains

Q1. Assess the impact of global warming on the coral life system with examples. **(2017)**

Q2. 'Climate change' is a global problem. How India will be affected by climate change? How Himalayan and coastal states of India will be affected by climate change? **(2017)**

Q3. Discuss global warming and mention its effects on the global climate. Explain the control measures to bring down the level of greenhouse gases which cause global warming, in the light of the Kyoto Protocol, 1997. **(2022)**

PDF Refernece URL: <https://www.drishtiias.com/printpdf/unesco-s-state-of-ocean-report-2024>

