



General Studies-3; Topic: Conservation, environmental pollution and degradation, environmental impact assessment.

Ocean Warming

Introduction

- The oceans play a key role in regulating climate.
- According to the UNESCO State of Ocean Report, world's understanding is still insufficient to design solutions for multiple ocean crises.

Present Status

- The global ocean has taken up more than 90% of the excess heat in the climate system.
- Since 1993, the rate of ocean warming has more than doubled.
- Oceans are heating up 40 percent faster on average than IPCC estimate.

Ocean Warming and its consequences

- The upper 2,000 metres (m) of oceans warming is leading to irreversible changes in the centennial to millennial time scales.
- Scientists are particularly concerned about the accelerated ocean warming in the past two decades.
- Increased greenhouse gas emissions from human activities is leading to increased uptake of the **Earth energy imbalance (EEI) by oceans.**
- EEI is the balance between incoming energy from the Sun and outgoing energy from the Earth.
- About 90 per cent of the EEI is being absorbed by oceans, resulting in a cumulative increase in ocean heat content (OHC).
- Increased OHC leads to deoxygenation.
- It can have long-term negative impacts on

- health of coastal and large marine ecosystems,
- a sustainable blue economy,
- coastal communities that depend on oceans
- tourism, fisheries, aquaculture, and ecosystem services.
- Arctic and Antarctic ice sheets are shrinking due to ocean warming.

Marine carbon dioxide removal (mCDR)

- **mCDR technology involves techniques that capture carbon dioxide from the air and store it durably.**
- Examples include
 - altering the chemical composition of seawater so that oceans absorb more carbon dioxide from the atmosphere.
 - adding nutrients such as iron to encourage the growth of microscopic plankton that can sink to the seafloor and be stored longer.
- There is growing number of start-ups developing mCDR techniques.
- Funding for mCDR research announced by the United States and the European Union in 2023.

Way Forward

- Need to provide regular data on how ocean warming is evolving and its impacts.
- Improve the space-based and in situ observing systems for monitoring sea level rise at global, regional, and coastal scales.
- **Expanding coastal blue carbon habitats such as mangrove forests, seagrass meadows, and tidal saltmarshes to increase the sequestration of carbon.**