



OCEAN WARMING - GS III MAINS

Q. Addressing the root causes of rising sea surface temperature is crucial to mitigate the impacts of ocean warming and protect both marine and human well-being. Elucidate (15 marks, 250 words)

News: *Global ocean heat has hit a new record every single day for the last year*

What's in the news?

- The world's oceans have now experienced an entire year of unprecedented heat, with a new temperature record broken every day, new data shows.
- The average global sea surface temperature (SST) for February 2024 stood at 21.06 degree Celsius.
- This is the highest recorded temperature in a dataset that goes back to 1979. The previous record of 20.98 degree Celsius was set in August 2023.

Causes of Ocean Warming:

1. Greenhouse Gas (GHG) Emissions:

- Since the Industrial Revolution, human activities such as burning fossil fuels have released high levels of GHGs in the atmosphere.
- Carbon dioxide, methane, ozone and nitrous oxide are some of the notable GHGs, which essentially trap heat in the atmosphere and contribute to global warming.
- As a result, the average global temperature has risen at least 1.2 degree Celsius above pre-industrial times.

2. Heat Absorption:

- Almost 90 percent of the extra heat trapped by GHGs has been absorbed by the oceans, making them steadily warmer over the decades.

3. Deforestation:

- Deforestation reduces the number of trees available to absorb CO₂ from the atmosphere.
- It leads to higher concentrations of GHGs, contributing to global warming and consequently, ocean warming.

4. Melting Ice:

- As global temperatures rise, polar ice caps and glaciers melt, adding freshwater to the oceans.
- This influx of freshwater can disrupt ocean currents and contribute to changes in temperature and salinity, further affecting ocean warming.



5. Impact of El Niño:

- El Niño is a weather pattern that refers to an abnormal warming of surface waters in the equatorial Pacific Ocean.
- It has contributed to both ocean warming and rising global surface temperatures.

6. Natural Variability:

- While human activities are the primary driver of recent ocean warming, natural factors such as volcanic eruptions, changes in solar radiation, and ocean currents also play a role in short-term variations in ocean temperature.

Consequences of Ocean Warming:

1. Ocean Stratification:

- Warmer oceans lead to increased ocean stratification, which disrupts the mixing of water layers.
- This affects the ocean's ability to absorb carbon dioxide and oxygen, endangering marine life by hindering the circulation of nutrients necessary for the survival of phytoplankton, the foundation of many marine food webs.

2. Marine Heatwaves (MHWs):

- Furthermore, marine heatwaves (MHWs), more intense and frequent due to higher SSTs, have devastating effects on marine ecosystems, including coral bleaching and altered migration patterns of aquatic animals. This can lead to the collapse of marine ecosystems.

3. Enhanced Storm Severity:

- On a broader scale, higher ocean temperatures contribute to the severity of storms, such as hurricanes and cyclones, by increasing their moisture content and wind speeds, resulting in more significant destruction and flooding when they make landfall.

4. Rising GHG Levels:

- The continuous rise in GHG levels, reaching record highs in 2023 according to C3S, underscores the urgency of reducing emissions to mitigate these impacts.
- However, global efforts to decrease GHG emissions remain insufficient, posing ongoing risks to both marine ecosystems and human societies.

Impacts of Ocean Warming:

1. Ocean Acidification:

- Warmer SSTs can exacerbate ocean acidification, a process driven by the absorption of CO₂ from the atmosphere.
- Increased CO₂ levels lower the pH of seawater, making it more acidic.
- This acidification can harm marine organisms with calcium carbonate shells or skeletons, such as shellfish, corals, and some planktonic species, impacting entire marine food webs.



2. Coral Bleaching:

- Corals are highly sensitive to changes in SSTs. When waters become too warm, corals expel the algae living in their tissues, causing them to turn white or bleach.
- Bleached corals are stressed and more susceptible to disease and death.

3. Threat to Marine Life:

- The rise in temperatures, however, has made it harder for water layers to mix with each other.
- Due to this, oxygen absorbed isn't able to mix properly with cooler ocean waters below, threatening the survival of marine life.

WAY FORWARD:

1. Strengthening Scientific Research:

- Governments can spend more money on scientific research to measure and track the effects of ocean warming.
- This will make it easier to create and implement necessary and appropriate mitigation and adaptation strategies by giving more exact data on the scope, nature, and effects of ocean warming.

2. Improving Human Adaptation:

- To predict and manage marine disease outbreaks, new monitoring techniques can be created.

3. Restoring Marine and Coastal Ecosystem:

- This can involve creating artificial structures like rock pools that serve as substitute homes for living things or increasing a species' resistance to warming temperatures through assisted breeding methods.

4. Limiting GHG Emissions:

- The Paris Agreement's mitigation goals must be swiftly met if we're to keep the rise in the world's average temperature to well under 2°C above pre-industrial levels.
- This will help mitigate the significant and long-lasting effects of rising temperatures on ocean ecosystems and the services they provide.

Addressing the root causes of rising sea surface temperature, primarily anthropogenic greenhouse gas emissions, is crucial to mitigating these impacts and protecting both marine and human well-being.