

# Warming of Indian Ocean set to accelerate: study

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From 1950 to 2020, the Indian Ocean had become warmer by 1.2 degrees Celsius, and climate models expect it to heat up a further 1.7 degrees Celsius to 3.8 degrees Celsius from 2020 to 2100. While we are familiar with heatwaves on land, "marine heatwaves", their counterparts in the sea and linked to the rapid formation of cyclones, are expected to increase ten-fold from the current average of 20 days per year to 220-250 days per year.

## 'One Hiroshima bomb'

Mostly attributable to global warming, the tropical Indian Ocean will likely be in a "near-permanent heatwave state" and accelerate coral bleaching, seagrass destruction, and loss of kelp forests, affecting the fisheries sector adversely, said an analysis led by



The tropical Indian Ocean will likely be in a 'near-permanent heatwave state'. FILE PHOTO

scientists at the Indian Institute of Tropical Meteorology (IITM), Pune.

The heating of the ocean was not merely restricted to the surface but went deeper and increased the overall "heat content" of the ocean. The heat content of the Indian Ocean, when measured from surface to a depth of 2,000 metres, is currently increasing at the rate of 4.5 zetta-joules per decade, and is predicted to increase at a rate of 16-22 zet-

ta-joules per decade in the future. Joule is a unit of energy and one zetta-joule is equal to one billion-trillion joules ( $10^{21}$ ). "The future increase in heat content is comparable to adding the energy equivalent of one Hiroshima atomic bomb detonation every second, all day, every day, for a decade," said Roxy Mathew-Koll, scientist at IITM and lead author of the study.

The study constitutes a chapter in a forthcoming publication *The Indian Ocean and its role in the global climate system* by Elsevier.

Rising heat content contributes to sea-level rise also. Heat causes the volume of water to increase, called the thermal expansion of water, and this is responsible for more than half of the sea-level rise in the Indian Ocean – larger than the changes arising from glacier and sea-ice melting.

- 1. Elaborate on the factors contributing to the rapid warming of the Indian Ocean. Discuss the potential consequences of this warming on the Indian monsoon system. Suggest measures to mitigate these consequences. (250 words)**
- 2. The Indian Ocean is particularly vulnerable to the impacts of climate change. Explain how rising sea levels due to Indian Ocean warming threaten India's coastal regions. Analyze the socio-economic implications of these threats. (250 words)**
- 3. Marine heatwaves are becoming more frequent and intense in the Indian Ocean. What are the ecological implications of these heatwaves for marine ecosystems? Critically evaluate India's role and initiatives in international cooperation for research and management of the Indian Ocean. (250 words)**



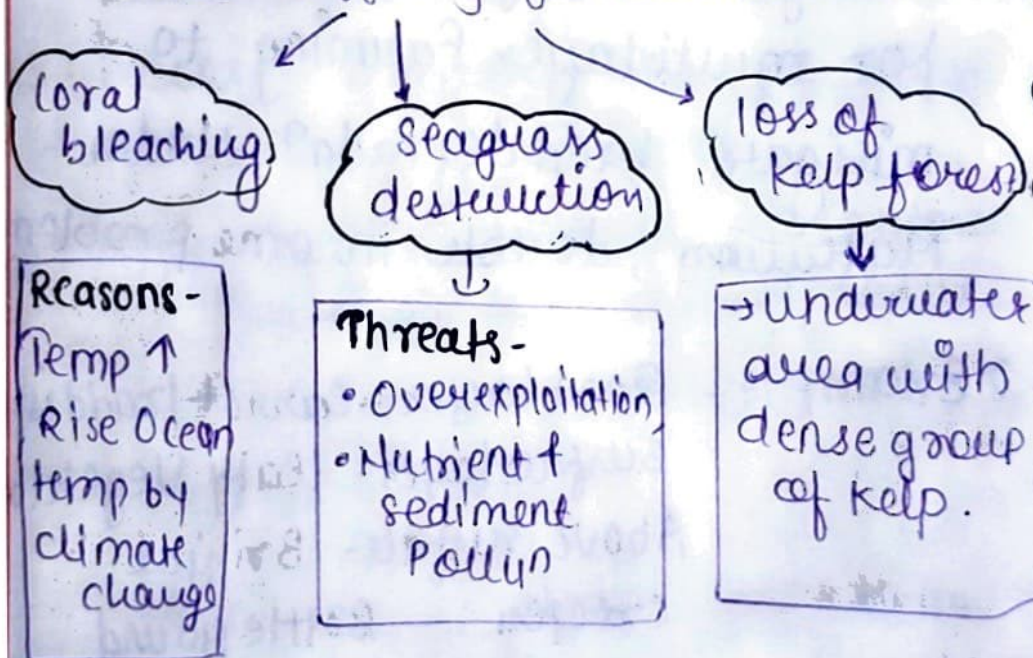
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→ From 1950-2020 Indian Ocean become warmer by 1.2 °C and expected to heat up 1.7 °C - 3.8 °C from 2020-2100.

→ Marine heatwaves making movement of water rapid & high risk of cyclone 20 days per year to 220-200 day/year.

→ Factors affecting fisheries sector:



→ Thermal Expansion takes place, Melting glacier & sea-ice causes of sea-level rise ↑