Colonialism and imperialism exploit the economic resources and control the political system of a country and in this process their development takes place at the cost of the colonized people. The values and principles enshrined in the UN Charter must be adhered to while also finding a solution to the long pending issue of colonization of the remaining territories of the world. This would herald a new era in the development of the world, which would be based on values and principles of human rights rather than self-interest.

15. What are Marine Heat Waves (MHW)? Identify the causes of their formation and discuss their consequences for India. (250 words) 15

Approach:

- Start with a brief concept about Marine Heat Waves (MHW).
- Highlight the factors responsible their formation.
- Discuss their consequences for India.
- Conclude accordingly.

Answer:

Marine heat waves (MHWs) **occur when seawater temperatures exceed a seasonally varying threshold for at least 5 consecutive days**. Successive heatwaves with gaps of 2 days or less are considered to be a part of the same event. During a MHW, the average **temperature of the ocean surface up to a depth of 300 feet go 5-7 degrees Celsius above normal.**

MHWs have been **recorded in surface and deep waters, across all latitudes, and in all types of marine ecosystems**. They can occur in **summer or winter**. They are defined based on differences with expected temperatures for the location and time of year.

Causes of Marine Heat Waves:

MHWs are considered to be the direct result of local-scale processes acting within the mixed layer (e.g., ocean heat advection, air-sea interaction or vertical mixing), which can be modulated by remote influences (e.g., climate modes such as ENSO) and their teleconnections.

- **EL-Nino Southern Oscillation (ENSO):** The increase in the Sea Surface Temperature during EL Nino in the eastern tropical Pacific results in MHW events in the tropical latitudes. In the Indian Ocean, it is supported by positive Indian Ocean Dipole and in the tropical Atlantic, by negative North Atlantic Oscillation.
- **Increased Sea surface temperatures (SST):** Sea Surface Temperatures have increased at a rate of nearly 0.6°C per century. This warming has increased the likelihood of marine heatwaves occurring.
- **Ocean Currents**: The most common drivers of marine heatwaves include Ocean currents, which can build up areas of warm water and air-sea heat flux or warming through the ocean surface from the atmosphere. Winds can enhance or suppress the warming in a marine heatwave.
- **Anthropogenic factors**: Around 90 per cent of the warming caused by greenhouse gas emissions is absorbed by the oceans. Climate change is causing ocean warming globally, and regionally MHWs are driven by unusual weather patterns and disruptions in ocean currents and mixing.

Consequences of MHW on India:

- **Habitat destruction:** These events cause habitat destruction due to coral bleaching, seagrass destruction and loss of kelp forests, affecting the fisheries sector adversely.
- **Impact on Monsoons:** The marine heat waves in the Indian Ocean have an impact over the Southwest Monsoon, which is the main rain-bearing system over the Indian subcontinent. The MHWs reduce monsoon rainfall over central India. However, the occurrence in north Bay of Bengal increases rainfall over the southern peninsular area.
- **Natural calamities:** Higher water temperatures associated with MHWs can cause extreme weather events such as tropical storms and hurricanes, and disrupt the water cycle; making floods, droughts and wildfires on land more likely.