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Q14

Account for variations in oceanic salinity and discuss its multi-dimensional effects. (250 words).

UPSC Civil Services Mains 2017 · GS I · 15 marks · World's Physical Geography

Salient features of world's physical geography.

Core demand of the question

- Account for spatial variations in oceanic salinity
- Then discuss the multi-dimensional effects on circulation, climate, life, and human use

Revision summary

Average ocean salinity is about 35 ppt, but subtropics are saltier and river mouths and poles are fresher.

Enclosed gulfs can be extremely saline; the Baltic is brackish.

Salinity plus temperature sets density and helps drive the global conveyor.

The Arabian Sea-Bay of Bengal contrast is a clear monsoon-ocean effect.

Life, cyclones, desalination, and coastal soils all feel these spatial differences.

Introduction

Ocean water averages about 35 parts per thousand of dissolved salts, but that figure hides sharp regional contrasts. Evaporation, rainfall, river input, ice, and mixing set the pattern. Salinity then feeds back into density, currents, marine life, and even monsoon-margin climate.

Body**Why salinity varies**

- Subtropical highs, such as the North Atlantic and the Arabian Sea in the dry season, lose water to evaporation and gain little rain, so surface salinity rises.
- Equatorial belts receive heavy convection rain, so salinity is often lower than in the dry subtropics even though heat is high.
- Polar and subpolar seas are freshened by ice melt and low evaporation; sea-ice formation, by contrast, rejects brine and can locally raise salinity and density.
- Huge rivers-the Amazon, Congo, Ganga-Brahmaputra, and Mekong-create low-salinity plumes on the adjacent shelf, visible far offshore in the Bay of Bengal.
- **Enclosed and semi-enclosed basins diverge:** the Red Sea and Persian Gulf are highly saline; the Baltic and Black Sea surface layers are brackish because of runoff and limited exchange.
- Currents and upwelling mix water; the Mediterranean outflow is salty and dense, while monsoon reversal in the Indian Ocean seasonally reshapes the Arabian Sea-Bay of Bengal contrast.

Multi-dimensional effects

- **Density, with temperature, drives thermohaline circulation:** salty, cold water sinks in the North Atlantic and helps the global conveyor that redistributes heat.
- Fresh caps, as in the Bay of Bengal, stabilise the surface, affect cyclone heat supply, and change monsoon moisture and the depth of mixing.
- Marine organisms are adapted to salinity bands; estuaries host specialised fisheries, while coral and many open-ocean species fail if salt or runoff shifts too far.
- Sea ice, deep water formation, and possible Atlantic Meridional Overturning slowdown are climate risks if Greenland melt freshens the high-latitude Atlantic.
- **Human uses follow the map:** desalination is costlier in already salty gulfs only in energy terms of intake chemistry; ports and aquaculture must match local salt; naval and submarine acoustics change with density layers.
- Salt belts also shape salt pans, coastal soils, and mangrove limits, which is a landward effect of oceanic and lagoon salinity.

Indian Ocean illustration

- The Arabian Sea is typically saltier than the Bay of Bengal because of evaporation, fewer mega-deltas, and different monsoon freshwater. That contrast matters for monsoon modelling and for cyclone behaviour on the two coasts.

Way forward for the answer

- Give the water-budget causes first, name high and low seas, then chain density-climate-life-human use, with one Indian Ocean pair.

Flow diagram

Evaporation rain rivers ice -> Surface salinity pattern
Surface salinity pattern -> Density thermohaline flow
Surface salinity pattern -> Bay vs Arabian contrast
Density thermohaline flow -> Heat climate conveyor
Surface salinity pattern -> Fisheries mangroves desalination

Conclusion

Oceanic salinity varies because the water budget-evaporation, rain, rivers, ice, and mixing-is not the same in every basin. Those variations steer density-driven circulation, monsoon and cyclone settings, fisheries, and coastal livelihood. Salinity is therefore a climate and resource variable, not only a school figure of 35 ppt.

Facts & figures

Mean salinity ~35 ppt

Standard open-ocean average of dissolved salts, around which regional anomalies are measured.

Red Sea / Persian Gulf

High-evaporation enclosed basins with some of the world's highest surface salinities.

Baltic Sea

Low-salinity enclosed sea freshened by rivers and limited exchange with the North Sea.

Bay of Bengal plume

Ganga-Brahmaputra and monsoon rain create a fresh surface layer unlike the saltier Arabian Sea.

Thermohaline circulation

Density-driven deep flow in which temperature and salinity together move heat through the world ocean.

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