



SEA LEVEL RISE - GS III MAINS

Q. Rising sea level has multifaceted causes and impacts, requiring coordinated efforts at the national and international levels. Examine (15 marks, 250 words)

News: *Where sinking cities are pushing sea level rise into overdrive*

What's in the news?

- Dozens of cities along the US coastline are sinking at alarming rates, leaving them far more exposed to devastating flooding from sea level rise than previously thought.

Key takeaways:

- As oceans rise and the coasts sink, up to 343,000 acres of land will be exposed to destructive flooding by 2050, from hazards such as hurricanes, coastal storms and shoreline erosion, according to the study published in the journal Nature.
- In a worst-case scenario, roughly 1 in 50 people in the 32 cities analyzed could be exposed to flood threats.

Sea Level Rise:

- Rising sea levels are a global phenomenon that is caused by various factors such as climate change, melting of polar ice caps, and thermal expansion of ocean water.
- The possibility of sea level rise in the next ten years is about 3.2 cm in the north Indian Ocean if the sea level acceleration remains similar to 3.2 mm per year.
- The coastal regions of India, which are home to millions of people, are particularly vulnerable to the effects of this phenomenon.

Reason of Sea-Level Rise:

1. Thermal Expansion:

- Rising global temperatures cause seawater to expand as it absorbs heat, significantly contributing to sea-level rise.
- According to the National Oceanic and Atmospheric Administration (NOAA), thermal expansion is responsible for about 40-50% of the observed sea-level rise since 1900.

2. Melting Polar Ice Caps:

- Glaciers and ice sheets melt in Antarctica and Greenland releases freshwater into the ocean, accelerating sea-level rise.
- For example, the Larsen C ice shelf in Antarctica broke off an iceberg twice the size of Luxembourg in 2017, contributing directly to rising sea levels.



3. Glacial Retreat:

- Higher temperatures lead to glacier retreat worldwide, with meltwater flowing into the ocean and adding to rising sea levels.
- For example, The Gangotri Glacier in the Himalayas has been receding at an alarming rate, affecting freshwater supply and contributing to sea-level rise.

4. Increased Carbon Emissions:

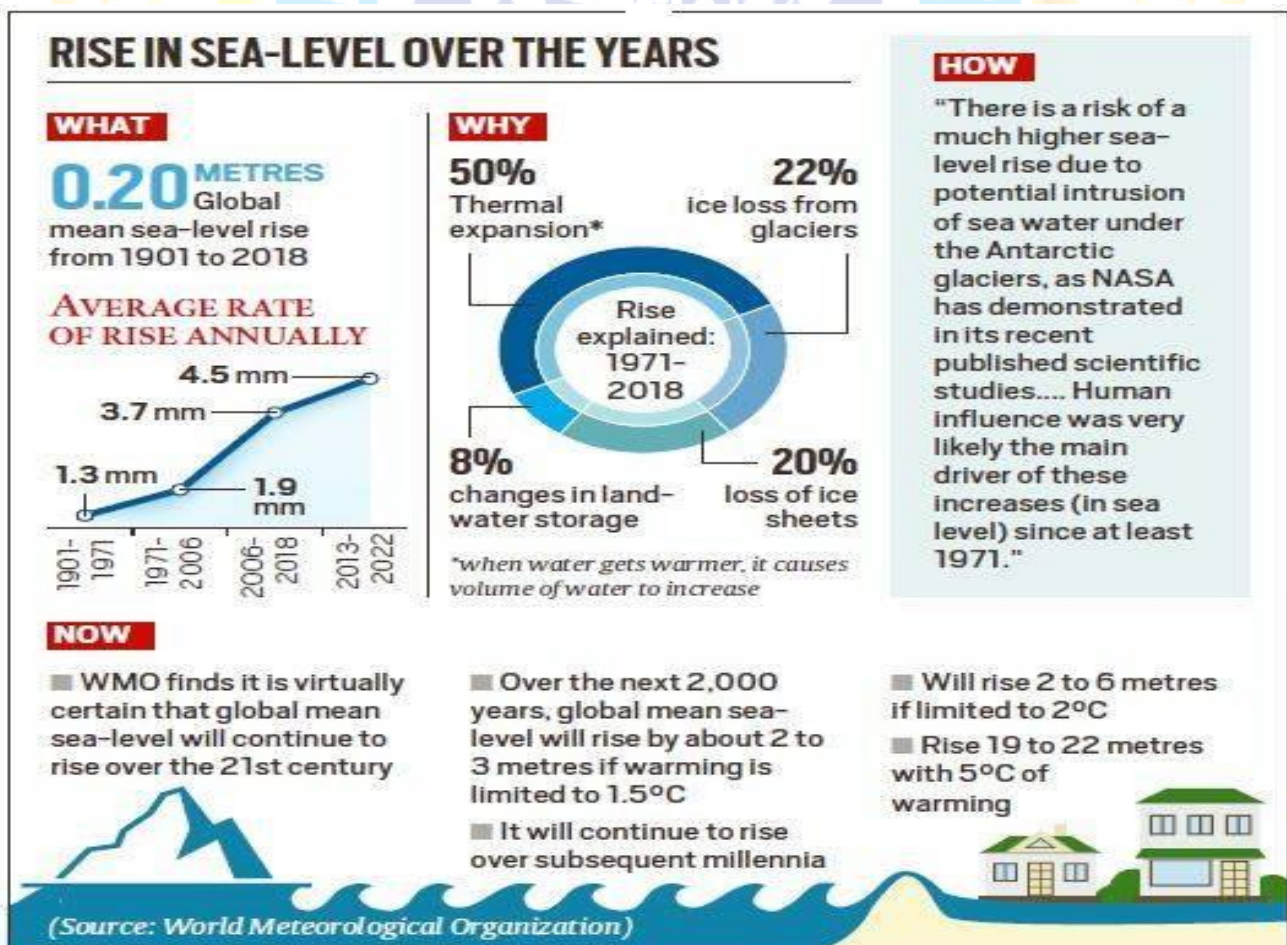
- Heavy industrial activities, particularly in China's coal belt and the United States, release massive amounts of CO₂, accelerating global warming and, consequently, ice melt and thermal expansion.

5. Tectonic Activity:

- Earthquakes and volcanic eruptions can induce sudden, localised sea-level fluctuations.
- The 2004 Indian Ocean earthquake, for instance, brought significant, albeit temporary, changes to sea levels in the region, leaving lasting impacts on local geographies.

6. Land Subsidence:

- Urban centres like Jakarta experience land subsidence due to excessive groundwater extraction for daily use, causing the land to sink and resulting in a relative sea-level rise.





Impact of Sea Level Rise:

1. Impact on Island States and Coastal Cities:

- Large coastal urban centers located on low-lying coastal areas will become prone to flooding.
- High and low tide lines will advance landward, part of the present intertidal zone will become permanently submerged and, consequently, significant land loss is likely to occur.
- It will cause extensive submergence of low-lying deltaic plains.
- Large coastal urban centres like Mumbai, Chennai, Kolkata, New York, London, Shanghai, Dhaka, Bangkok, Jakarta, Lagos, Cairo, Copenhagen, Los Angeles, Buenos Aires and Santiago etc. are vulnerable.
- Small Island States with low elevation like Kiribati, Maldives, Solomon Islands, Micronesia, Tuvalu, Palau etc. face threat of complete submergence with rise in sea levels. This will lead to large scale climate-induced migration.

2. Impact on Freshwater:

- Freshwater in coastal delta and estuaries will get contaminated by salt sea-water.
- Water and soil salinity along the coast will increase with the rise in sea levels, destroying normal characteristics of coastal soil and water.
- It is already a major issues in Sunderbans delta in West Bengal and Bangladesh.

3. Impact on Coastal Ecosystems:

- The Sundarbans are the largest mangrove forest in the world, covering 6,500 sq. km. The Sundarbans will be completely lost with 1m rise in ocean levels (World Bank, 2000). It will be a great loss of heritage, biodiversity, fishery resources, life and livelihoods.
- Salinity intrusion has led to 'top-dying' disease in Sundari trees. A 2018 report has pointed out that in the last 30 years, 1.44 million cubic meters of Sundari trees have been lost to 'top-dying' disease.

4. Impact on Fisheries and Aquaculture:

- The rise in sea level will have a significant impact on fish habitat and their breeding ground.
- Rise in water levels will change the location of river estuaries. It will have a significant impact on fisheries, aquaculture and consequently on the livelihoods of coastal populations.

5. Coastal Erosion:

- Sea level rise will cause increased coastal erosion as water will wash out topsoil of the coast.
- In addition to this, the backwater effect is accelerated by sea level rise that will also cause erosion.
- The forecasted land erosion will lead to displacement of coastal population.

6. Impact on Agriculture:

- The landward shift of water salinity boundary will cause salinity intrusion in land which will decrease agricultural production in coastal areas.
- It will also cause soil degradation.



- Salinity also diminishes the germination rate of some plants.
- A World Bank (2000) study suggested that increased salinity alone from a 0.3 metre sea level rise will cause a net reduction of 0.5 million metric tonnes of rice production.
 - Salinity intrusion degrades soil quality which in turn inhibits rice production.

7. Impact on Health:

- Reduction of freshwater in coastal regions can cause water-related diseases like diarrhoea.
- Decrease in food production can contribute to malnutrition among coastal populations.
- Flooding in coastal areas can increase outbreaks of water-borne diseases like cholera.

8. Extreme Events:

- Coastal countries will face extreme events.
- Cyclones are already intensifying rapidly due to more moisture and heat from warming of oceans.
- Cyclones are bringing more rain than earlier e.g., Super Cyclone Amphan (2020) caused large-scale flooding and inundated tens of kms inland with saline water.

9. Cascading and Compounding Impacts:

- Sea-level rise will bring cascading and compounding impacts.
- Losses of coastal ecosystems and ecosystem services, groundwater salinization, flooding and damage to coastal infrastructure will cascade into risks to livelihoods, settlements (causing displacement), health, well-being, food security, water security, and cultural values in the near to long-term.

WAY FORWARD:

1. Reducing Greenhouse Gas Emissions:

- Measures to slow the rate of sea level rise in the long term.
- For example - Carbon Capture and Sequestration.

2. Adaptation Measures:

- Building seawalls, enhancing natural defences like mangroves and improving early warning systems.
- For example - the Great Garuda Seawall by Indonesia.

3. Sustainable Development:

- Encouraging sustainable coastal development and land-use planning.
- For example - the National Coastal Mission.

4. International Collaboration:

- Collaboration to address transboundary challenges and share knowledge and resources.
- For example - the UN Framework Convention on Climate Change (UNFCCC).

A one-meter sea level rise have multifaceted impacts, requiring coordinated efforts at the national and international levels, to adapt and mitigate these challenges