6. Tidal Rise-Induced Coastal Flooding- Environment

Kerala has declared tidal rise-induced coastal flooding that harms communities and causes loss of life and livelihood as a State-specific disaster.

This is the first time in the country that a State has declared tidal flooding a State-specific disaster.

Affected Areas - Along the Kerala coast, particularly in areas such as Vypin, Chellanam, Edakochi, and Perumbadappu in the Kochi Corporation, as well as Kumbalanghi panchayat.

I. Conceptual Understanding

Tidal flooding refers to temporary inundation of low-lying coastal areas when sea levels exceed normal high-tide thresholds, even in the absence of rainfall, cyclones, or storm surges. It occurs when regular tidal oscillations cross critical elevation benchmarks, overwhelming drainage systems. It is distinct from extreme weather-induced coastal flooding because it can occur under normal meteorological conditions.

Key Terminologies

Sunny Day Flooding / King Tide Flooding

1. Flooding during unusually high astronomical tides.
2. Occurs under clear skies without storm activity.

Astronomical Tides

1. Driven by gravitational forces of the moon and sun.
2. Highest during full moon and new moon (spring tides).

II. Severity Classification of High-Tide Flooding

Minor Flooding (≈ 0.55 m above average high tide)

1. Temporary road closures
2. Stormwater drainage backups
3. Short-term transport disruption

Moderate Flooding (≈ 0.85 m above average high tide)

1. Water intrusion into homes and commercial spaces
2. Damage to infrastructure
2. Interruption of utilities

Major Flooding (≈ 1.20 m above average high tide)

1. Severe property damage
2. Evacuations
3. Major infrastructure repair
4. Long-term livelihood impact

These classifications are used in international coastal monitoring systems and adapted regionally.

III. Causes of Tidal Flooding

1. Astronomical Drivers

1. Spring tides during full and new moon phases raise baseline sea levels.
2. Alignment of Earth–Moon–Sun gravitational forces intensify tidal amplitude.

2. Meteorological Amplifiers

1. Offshore storms and persistent winds push water toward coastlines.
2. Even distant storm systems can elevate regional sea levels.

3. Sea-Level Rise

1. Long-term climate change-induced thermal expansion of oceans.
2. Melting of polar ice sheets increases mean sea level.
3. Reduces the threshold for flooding—smaller tides now cause inundation.

4. Ocean-Atmosphere Variability

Frequency varies due to large-scale climate systems like -

1. El Niño Southern Oscillation (ENSO)

2. Regional ocean circulation shifts

During El Niño phases, high-tide flooding frequency increases in some coastal regions due to altered wind and ocean current patterns.

5. Local Geomorphological Factors

1. Siltation of rivers and estuaries reduces drainage capacity.
2. Urban encroachment on wetlands blocks natural flood buffers.
3. Poor stormwater infrastructure exacerbates waterlogging.

IV. Distinction from Cyclone-Induced Storm Surges

Parameter	Tidal Flooding	Storm Surge
Trigger	Astronomical tides + minor meteorological factors	Cyclones or severe storms
Frequency	Occurs regularly (often twice daily in vulnerable zones)	Episodic
Spatial Scale	Highly localized (city blocks)	Large coastal stretches
Intensity	Usually low to moderate	Potentially catastrophic

Tidal flooding is chronic and recurrent, whereas storm surges are acute and episodic.

V. Legal and Statutory Framework

Disaster Management Act, 2005

Under Section 2(d), a disaster includes natural events causing substantial loss of life, property or environmental damage beyond community coping capacity.

Tidal flooding qualifies if it -

1. Disrupts livelihoods
2. Causes displacement
3. Damages infrastructure

Financial Implications- States may use the State Disaster Response Fund (SDRF). For large-scale disasters beyond state capacity, assistance may be sought from the National Disaster Response Fund (NDRF).

VI. Kerala - A High-Vulnerability Case Study

1. Unique Physiography

1. Narrow coastal plain between Arabian Sea and Western Ghats.
2. Extensive backwaters and estuarine systems.
3. High population density along coastline.

2. Low-Lying Regions

1. Kuttanad region (Alappuzha) lies below sea level.
2. Cities like Kochi are close to mean sea level.

3. Anthropogenic Factors

1. Encroachment into wetlands and floodplains.
2. Construction on puramboke lands and riverbanks.
3. Degradation of mangroves (natural buffers).

4. Siltation and Drainage Issues

1. Rivers and backwaters have reduced depth due to sediment deposition.
2. Lower hydraulic gradient reduces outflow during high tide.

VII. Impacts of Tidal Flooding

1. Environmental Impacts

Salinity intrusion into -

1. Groundwater aquifers
2. Agricultural land

Reduced paddy productivity in Kuttanad. Coconut plantations affected by soil salinization.

2. Economic Impacts

Fisheries disruption

1. Damage to nets and boats
2. Impact on fish landing centres

Damage to coastal tourism infrastructure. Increased recurring disaster expenditure.

3. Social Impacts

1. Around 10% of Kerala's population affected.
2. Vulnerable communities in informal settlements disproportionately impacted.
3. Repeated flooding erodes household savings.

VIII. Implications of Declaring Tidal Flooding a State-Specific Disaster

Financial Benefits

1. Enables structured compensation under SDRF norms.
2. Institutionalizes relief and rehabilitation mechanisms.

Administrative Clarity

1. Standard operating procedures (SOPs) for response.
2. Inclusion in State Disaster Management Plans.

Fiscal Burden

1. Recurring events increase strain on SDRF resources.
2. May necessitate additional climate adaptation financing.

IX. National vs State Notified Disasters

Aspect	National Notified Disaster	State Notified Disaster
Authority	Central Government	State Government
Fund Source	NDRF + SDRF	SDRF
Scale	Multi-state or national	State-specific
Examples	Cyclones, Earthquakes, Tsunami	Coastal erosion, lightning, heatwave (if notified)

Kerala has notified additional state-specific disasters such as -

1. Coastal erosion
2. Lightning
3. Soil piping
4. Heatwave
5. Human–wildlife conflict
6. Shipwreck incidents

X. Policy and Adaptation Measures

Structural Measures

1. Coastal embankments and tidal barriers.
2. Restoration of mangroves and wetlands.
3. Desiltation of rivers and backwaters.

Non-Structural Measures

1. Land-use zoning regulations.
2. Early warning systems for high-tide alerts.
3. Community awareness and evacuation planning.

Climate Adaptation Strategy

1. Integration of tidal flooding into coastal zone management plans.
2. Long-term sea-level monitoring.
3. Climate-resilient infrastructure design.

Conclusion

Tidal flooding represents a chronic, climate-amplified coastal hazard distinct from storm surges. Its growing frequency reflects the interaction of sea-level rise, astronomical tides, geomorphological constraints and anthropogenic pressures.

In Kerala's case, unique physiography combined with unplanned urbanization and siltation intensifies vulnerability. Recognition under disaster management frameworks ensures financial and institutional support but underscores the need for structural climate adaptation and sustainable coastal governance.

Source - https -//www.thehindu.com/news/national/kerala/why-kerala-declared-tidal-flooding-a-state-specific-disaster-explained/article70641866.ece