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Sundarbans Loses 10–15% Ecological Resilience: Climate Crisis in the World's Largest Mangrove

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Sundarbans Loses 10–15% Ecological Resilience: Climate Crisis in the World's Largest Mangrove

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WHY IN NEWS:

A new scientific study published in April 2026 found that the Sundarbans mangrove ecosystem — the world's largest — lost **10–15% of its ecological resilience** between 2000 and 2024, amounting to 610–990 sq km of degraded forest. Climate change, rising sea levels, and increasing cyclone intensity are the primary drivers.

THE SUNDARBANS — AN OVERVIEW

The **Sundarbans** is the world's largest mangrove forest, spanning the delta of the Ganga-Brahmaputra-Meghna river system across India and Bangladesh.

FEATURE	DETAIL
Total area	~10,000 sq km (India: ~4,200 sq km; Bangladesh: ~5,800 sq km)
Location	West Bengal (India) + Khulna/Satkhira/Bagerhat (Bangladesh)
River delta system	Ganga–Brahmaputra–Meghna
UNESCO Status	World Heritage Site (India: 1987; Bangladesh: 1997; both separate inscriptions)
Ramsar Site	Yes — both Indian and Bangladesh portions
Biosphere Reserve	Sundarbans Biosphere Reserve (India side)
Tiger reserve	Sundarban Tiger Reserve — India's largest tiger reserve
Famous for	Only mangrove ecosystem with tigers (Royal Bengal Tiger — *Panthera tigris tigris*)

THE NEW STUDY: WHAT WAS FOUND

The study, using multi-temporal satellite imagery and ecological modelling, tracked **ecological resilience** — the capacity of the ecosystem to absorb disturbances and recover.

Key Findings

METRIC	VALUE
Resilience loss (2000–2024)	10–15% of total ecosystem resilience
Area degraded	610–990 sq km
Affected zones	Primarily coastal fringes and low-elevation interior islands
Most vulnerable areas	Southern Sundarbans (closer to Bay of Bengal coast)
Recovery rate	Declining — each disturbance takes longer to recover from

WHY IS THE SUNDARBANS DECLINING? THREE PRIMARY DRIVERS

1. Sea-Level Rise

- Global mean sea-level rise: ~3.7 mm/year (2024 data)
- Sundarbans sea-level rise: **8–10 mm/year** — faster than global average due to **land subsidence**
- Land subsidence: natural compaction of delta sediments + reduced upstream sediment flow (dams on Ganga and Brahmaputra tributaries)
- Effect: Increased tidal inundation, longer submergence periods — mangrove roots need air exposure to survive

2. Cyclone Frequency and Intensity

MAJOR CYCLONE	YEAR	IMPACT
Aila	2009	~1,000 sq km of mangrove damage
Amphan	2020	Strongest ever recorded in Bay of Bengal; ₹1 lakh crore+ damage; severe mangrove loss
Yaas	2021	Compounded Amphan damage before recovery
Remal	2024	Category 4; Sundarbans coastal strip heavily affected

As Indian Ocean warms, Bay of Bengal cyclone intensity (measured by wind speed and storm surge) is increasing. The Sundarbans acts as a **natural storm buffer** — but repeated intense storms are straining regenerative capacity.

3. Salinity Intrusion

- Freshwater flow into Sundarbans has declined sharply due to dams and barrages upstream on the Hooghly-Bhagirathi system
- The **Farakka Barrage** diverts water toward Kolkata port — reducing freshwater flushing of the Sundarbans
- Increased salinity stress forces many mangrove species to expend more energy on salt regulation, reducing growth and reproduction
- Species like *Sundari* (*Heritiera fomes* — the tree that gives Sundarbans its name) are particularly salt-stress sensitive

BIODIVERSITY AT RISK

The Sundarbans supports exceptional biodiversity:

SPECIES	STATUS
Royal Bengal Tiger	~100–110 individuals (Indian side); classified Endangered (IUCN)
Irrawaddy Dolphin	Vulnerable (IUCN); significant Sundarbans population
Gangetic River Dolphin	Endangered; national aquatic animal of India
Saltwater Crocodile	Vulnerable
Olive Ridley Sea Turtle	Vulnerable; nesting sites in adjacent coast
Fishing Cat	Vulnerable
Masked Finfoot	Endangered; rare sighting

Mangrove degradation directly threatens all of these by shrinking habitat, reducing prey base, and increasing saltwater exposure of freshwater-adapted species.

ECOSYSTEM SERVICES UNDER THREAT

The Sundarbans provides critical services beyond biodiversity:

1. **Coastal protection:** Mangroves absorb 75–90% of cyclone wave energy — protecting ~30 lakh people in coastal West Bengal and 10 crore+ in Bangladesh
2. **Carbon sink:** Mangroves sequester ~5–10 times more carbon per hectare than tropical forests (blue carbon)

3. **Fisheries:** Nursery ground for prawns, crabs, Hilsa — supporting ~4.5 million fishermen
4. **Livelihood:** Honey collection (Maulipada/Moule communities), non-timber forest products
5. **Climate regulation:** Buffers both temperature and moisture extremes in the Bay of Bengal system

POLICY RESPONSE — INDIA

Project Tiger / National Tiger Conservation Authority (NTCA)

- Sundarbans is a **Tiger Reserve** under Project Tiger (launched 1973)
- NTCA monitors tiger population via camera traps and genetic sampling

Integrated Management Plan

- India + Bangladesh: Joint management discussions under UNESCO's World Heritage framework
- SAGAR (Security And Growth for All in the Region) — India's maritime doctrine mentions Sundarbans ecology

Mangrove Alliance for Climate (MAC)

India is a founding member of the Mangrove Alliance for Climate (MAC), launched at COP27 (2022), which aims to double global mangrove coverage by 2030.

MISHTI Scheme (2023)

Mangrove Initiative for Shoreline Habitats and Tangible Incomes (MISHTI) — launched in Union Budget 2023-24:

- Target: Mangrove plantation along India's coastline
- States: West Bengal (Sundarbans), Odisha, Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra

UPSC RELEVANCE

PAPER	ANGLE
GS3 — Environment	Mangrove ecology; climate change impacts; biodiversity loss; ecosystem resilience
GS1 — Geography	Ganga-Brahmaputra delta; Bay of Bengal cyclones; sea-level rise; delta subsidence
GS3 — Economy	Blue carbon; fisheries; coastal protection services
GS2 — IR	India-Bangladesh transboundary ecosystem; UNESCO WHS obligations
Mains Keywords	Sundarbans, ecological resilience, sea-level rise, land subsidence, Cyclone Amphan, Cyclone Remal, Royal Bengal Tiger, MISHTI scheme, Mangrove Alliance for Climate, blue carbon, Farakka Barrage

FACTS CORNER

ITEM	DETAIL
Sundarbans total area	~10,000 sq km (India ~4,200 + Bangladesh ~5,800)
Resilience loss (2000–2024)	10–15% (610–990 sq km degraded)
UNESCO inscription (India)	1987
Tiger count (Indian side)	~100–110 individuals
Sea-level rise (Sundarbans)	8–10 mm/year (higher than global average due to subsidence)
Global sea-level rise average	~3.7 mm/year
Royal Bengal Tiger status	Endangered (IUCN)
Sundari tree	*Heritiera fomes* — gives Sundarbans its name
Mangrove carbon storage	5–10x more per hectare than tropical forests
MISHTI scheme	Mangrove Initiative for Shoreline Habitats and Tangible Incomes; Budget 2023-24
Mangrove Alliance for Climate	Launched COP27 (2022); India founding member
Cyclone Amphan	2020; strongest ever in Bay of Bengal
Farakka Barrage	Reduces freshwater flow → increases salinity in Sundarbans

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