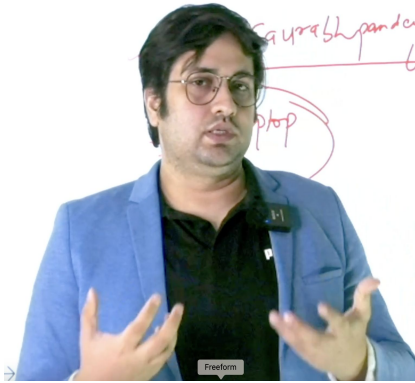
# Topics - MINDS MAPS included (Daily current affairs 29th December 2024

- Target UPSC CSE Prelims 2025
- Pacific Marine Heatwave and Seabird Decline.
- Lithocholic Acid and Lifespan Extension
- Neanderthal DNA and Human Genomes: New Insights
- Human Skin's Immune Capabilities
- Durian Flowering and Climate Impact
- Tropical Cyclones: Impacts and Predictions
- Mains



By saurabh Pandey

THE HINDU

# Target Mains -2025/26 -

**Q Essay topic →** “No one who does good work will ever come to a bad end, either here or in the world to come.”

**Q. Verra and Gold Standards recently seen in news are associated with which among the following. (Tol)**

**A) Solar panel production.**

**B) Heavy Water Reactors.**

**C) Green Hydrogen Production.**

**D) Carbon market**

# Target UPSC CSE PRELIMS 2025

Prelims Crash course - starting - 4th JAN

Science and tech course - 10th jan

Prelims current affairs course - 15th JAN

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# Marine heatwave killed four million Alaska seabirds

**The Hindu Bureau**

The 2014-2016 Pacific marine heatwave wiped out more than half – roughly four million – of Alaska's common murre (*Uria aalge*) seabirds, representing the largest documented vertebrate die-off linked to warming oceans, according to a new study. "Although research on the impacts of global warming on marine birds has clearly suggested major shifts in species' ranges and abundance, documented changes have been gradual (years to decades). To our knowledge, this study is the first to show that climate impacts can be swift (one year) and intense (eliminating half of the population)," authors of a study write. "Seabird mortalities are often observed in association with heatwaves, but population impacts are not well understood." Marine heatwaves – intense, prolonged, and expansive ocean warming events – are becoming increasingly common due to climate change. They are profoundly reshaping marine ecosystems globally.

These heatwaves lead to mass mortality of key habitat-forming species like kelps and corals, triggering cascading trophic effects that alter ecosystem productivity, displace lower-trophic-level species, and amplify food shortages for top predators. Although many upper-trophic-level species suffer from reduced reproductive success, increased mortality, and even mass die-offs due to marine heatwaves, broader population impacts are poorly understood.

Analysing colony counts before that period (2008-14), and after (2016-22), the authors documented a 52-78% population decline across 13 murre colonies, equating to the loss of four million birds within the span of less than two years. According to them, this represents the largest documented wildlife mortality event in the modern era. Moreover, the findings reveal no evidence of population recovery since, suggesting potential long-term ecosystem shifts and an overall diminished capacity to support historical seabird populations. "Recent population abundance estimates since then have found no evidence of recovery, suggesting that the heatwave may have led to an ecosystem shift," the Editor's summary says. "We suggest that the pronounced decline of an abundant and widespread upper trophic predator to less than half of its former population size in Alaska may signal a new threshold of response to global warming," they write.

# Topic → Pacific Marine Heatwave and Seabird Decline

## Impact of the 2014-2016 Pacific Marine Heatwave

🌊 The 2014-2016 Pacific marine heatwave resulted in the death of over four million common murre seabirds in Alaska, marking the largest vertebrate die-off linked to ocean warming.

📉 A study revealed a 52-78% decline in murre populations across 13 colonies from 2008-2014 to 2016-2022, indicating a significant and rapid impact of climate change.

🔍 This research is the first to document swift and intense climate impacts on marine birds, contrasting with previous gradual changes observed over years to decades.

# Broader Ecosystem Implications

🌐 Marine heatwaves, which are becoming more frequent due to climate change, disrupt marine ecosystems by causing mass mortality of key species like kelps and corals.

🦅 The study found no evidence of population recovery for the common murre since the heatwave, suggesting long-term shifts in the ecosystem and reduced capacity to support seabird populations.

⚠️ The decline of a major upper trophic predator like the common murre may indicate a new threshold of ecological response to global warming.

📊 The findings highlight the need for further understanding of broader population impacts and the cascading effects of marine heatwaves on marine ecosystems.

Summary: The 2014-2016 Pacific marine heatwave led to a dramatic decline of over four million common murre seabirds in Alaska, indicating severe and potentially long-lasting impacts of climate change on marine ecosystems

# A study shows why eating less slows aging

A component of bile called lithocholic acid can extend the lifespan of some animals. Researchers found, in mice, that levels of the acid rise during calorie restriction and that it activates a protein called AMPK, which scientists have already linked to the health benefits of eating less. When nematodes and fruit flies were fed lithocholic acid, the animals lived significantly longer than those that had not been given it. There is no evidence yet that lithocholic acid will have the same effect in humans.

# Topic→ Lithocholic Acid and Lifespan Extension

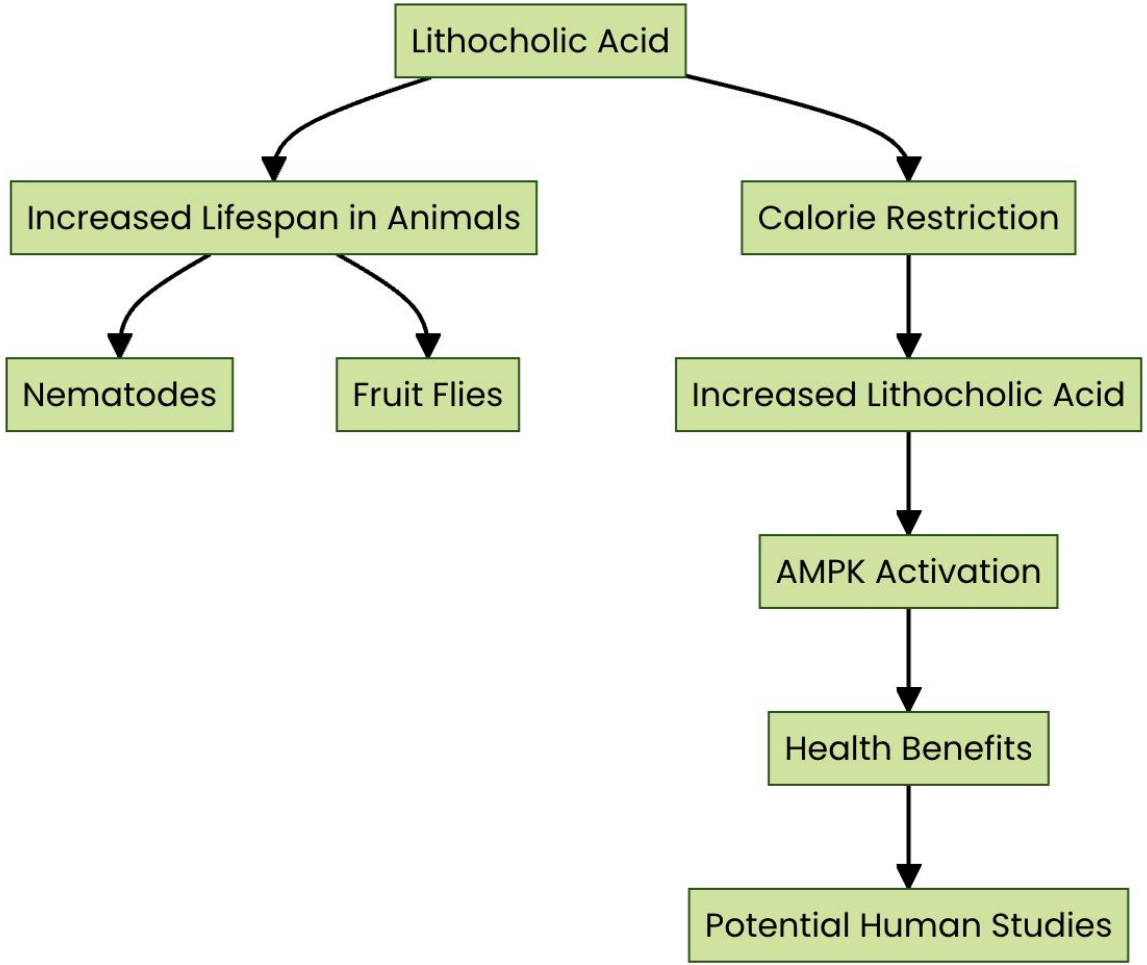
## Overview

🧬 Lithocholic acid, a bile component, has been shown to extend the lifespan of certain animals.
🐭 In mice studies, lithocholic acid levels rise during calorie restriction.
⚙️ It activates the AMPK protein, linked to health benefits from reduced food intake.
🪱 Nematodes and fruit flies fed lithocholic acid lived significantly longer than those not receiving it.
❓ No current evidence supports similar lifespan-extending effects in humans.
🔬 Research suggests a potential link between calorie restriction and increased lithocholic acid levels.
🧪 Further studies are necessary to explore its effects on human longevity.

## Research Insights

Animal Studies: Positive lifespan extension observed in nematodes and fruit flies.
Human Implications: Effects remain unproven; more research is needed

**Conceptual Diagram:**



# Neanderthal DNA got into humans earlier than thought

Two studies now suggest that Neanderthal DNA entered human genomes virtually overnight, much more recently than was thought. One study finds that modern humans and Neanderthals interbred in a roughly 7,000-year period; the other finds that the mixing took place between 45,000 and 49,000 years ago. The results come in part from the oldest human genomes ever sequenced: a male *Homo sapien* found near Ranis, Germany and a female *Homo sapien* from Czech Republic.

# Topic → Neanderthal DNA and Human Genomes: New Insights

## Recent Discoveries in Neanderthal DNA

🧬 Neanderthal DNA has been found to enter human genomes more recently than previously believed.

⏳ Interbreeding Period: Occurred over approximately 7,000 years.

📅 Timeline: Interbreeding events are dated between 45,000 and 49,000 years ago.

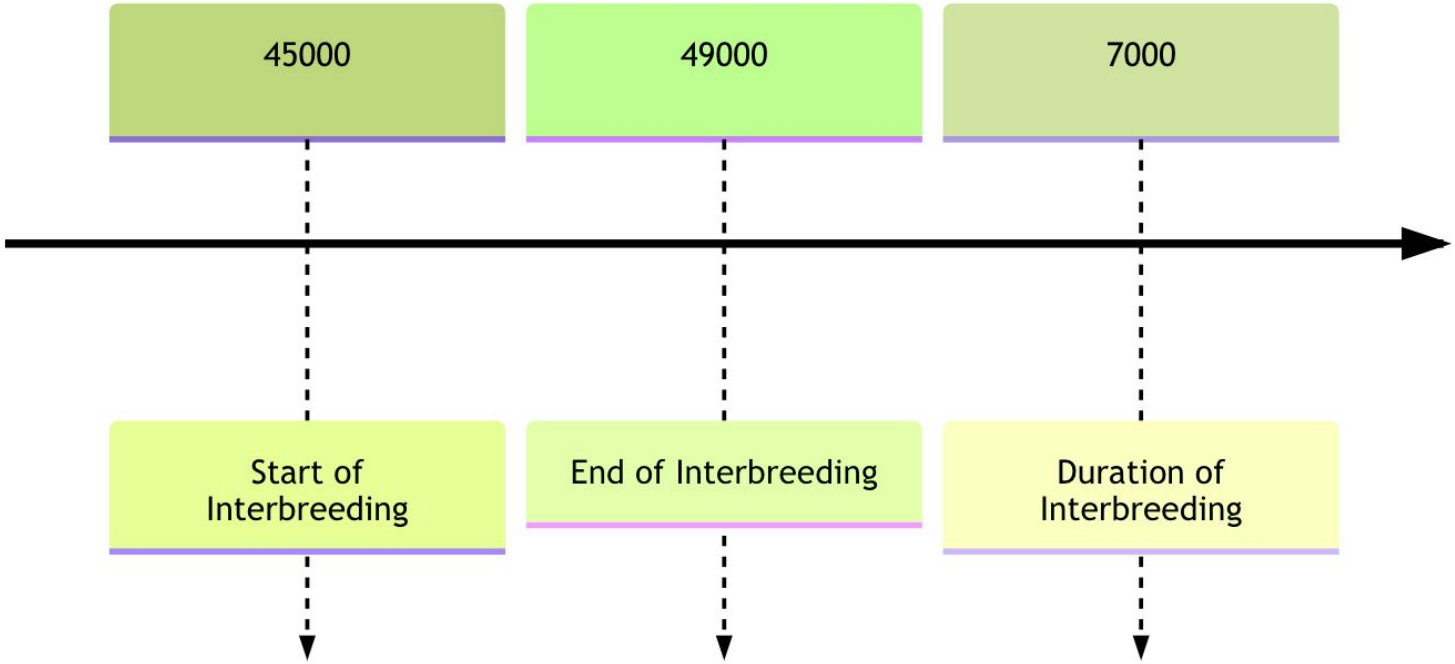
🧑‍🔬 Research Basis: Findings are based on the oldest human genomes ever sequenced.

🇩🇪 German Discovery: A male Homo sapien genome was discovered near Ranis, Germany.

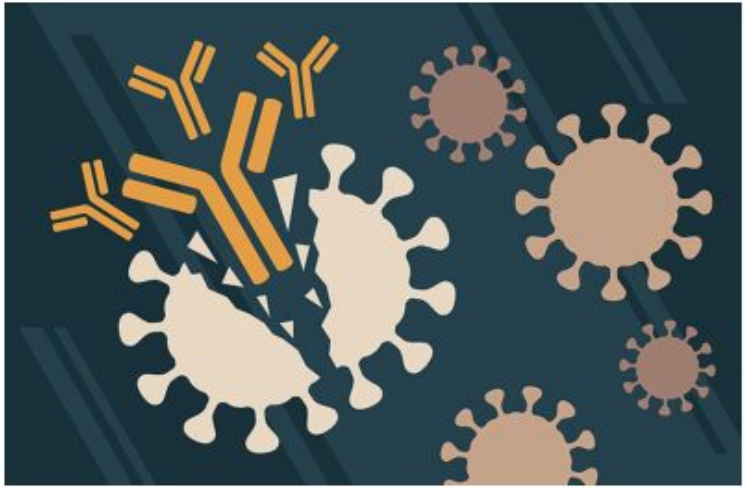
🇨🇿 Czech Discovery: A female Homo sapien genome was found in the Czech Republic.

🔬 New Insights: These studies provide fresh perspectives on the timeline of human-Neanderthal interactions

# Neanderthal and Human Interbreeding




**Summary:** Recent studies reveal that Neanderthal DNA entered human genomes much more recently than thought, with interbreeding occurring between 7,000 and 49,000 years ago, based on ancient human genomes from Germany and the Czech Republic.



# Skin produces antibodies to keep bacteria in check

The human skin seems to be able to produce its own antibodies to keep microbes in check. In mice colonised by *Staphylococcus epidermidis*, a bacterium found on skin, the skin was able to generate antibodies even when other parts of the immune system were disabled. And this surprise power might be harnessed to fight pathogens: when researchers modified *S. epidermidis* to display part of the tetanus toxin, the skin response protected mice from a lethal dose.

# Topic → Human Skin's Immune Capabilities

## Skin's Antibody Production

🦠 Human skin has the ability to produce its own antibodies to combat microbes.

🐭 In mice studies, skin generated antibodies even when other immune system parts were disabled.

🔬 Staphylococcus epidermidis, a skin bacterium, is crucial in this antibody production process.

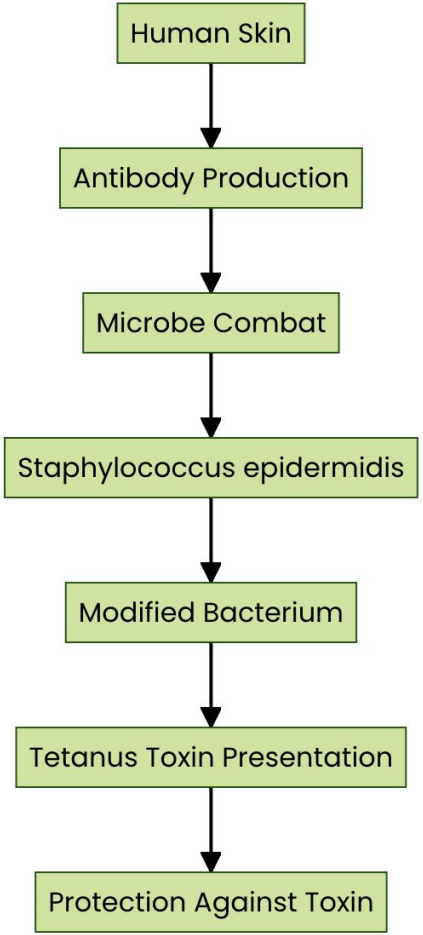
⚗️ Researchers modified S. epidermidis to present a part of the tetanus toxin.

🛡️ The modified skin response protected mice against a lethal dose of the toxin.

💡 This discovery suggests potential for harnessing skin's immune capabilities to fight pathogens.

🌍 The findings could lead to new strategies in immunology and pathogen defense.

**Antibody Production Process:**




**Summary:** Human skin can autonomously produce antibodies, offering potential for innovative pathogen defense strategies.

## Question Corner

# Durian flowering

**What triggers the flowering of durians?**

Based on observations of 110 durian plants, researchers have discovered that around 15 days of dry weather can trigger the flowering of durian plants. The flowering occurred around 50 days after an approximately 15-day dry spell, independent of whether the plant was grafted or grown from a seed. The team found that durian plants flowered approximately 50 days after a prolonged period of dry weather. These dry spells needed to be long enough to show up in moving average traces, specifically periods where rainfall averaged over 15-day windows was less than 1 mm. They proposed that there was some relationship between the flowering of durian and the more general burst of flowering seen in the tropics following long dry spells. But such general flowering events require a longer dry spell of around 30 days to occur. This explains why durians tend to flower multiple times a year, while synchronised flowering across species occurs once every few years.

Readers may send their questions / answers to questioncorner@thehindu.co.in

# Topic → Durian Flowering and Climate Impact

## 🌧️ Dry Weather Trigger

Observation: 110 durian plants studied.
Trigger: 15 days of dry weather initiates flowering.

## 🌼 Flowering Timeline

Occurrence: 50 days post 15-day dry spell.
Consistency: Applies to both grafted and seed-grown plants.

## 📊 Rainfall Measurement

Definition: Dry spells are periods with <1 mm rainfall over 15 days.

## 🌍 Tropical Flowering Connection

Insight: Links durian flowering to tropical flowering bursts post-dry spells

## ⏳ Longer Dry Spells for Synchronization

Requirement: 30-day dry spells needed for synchronized flowering across species.

## 🌱 Multiple Flowering Events

Durian: Flowers multiple times annually.
Other Species: Synchronized flowering occurs once every few years.

## 🔍 Research Significance

Impact: Highlights climatic influence on durian flowering patterns.

Summary: Research indicates a 15-day dry spell triggers durian flowering 50 days later, offering insights into tropical flowering dynamics.

# Durian Plants: The King of Fruits

## Overview

🌳 Durian plants are tropical trees renowned for producing the durian fruit, often dubbed the "king of fruits."
🍈 The scientific name for the durian plant is Durio, with multiple species cultivated for their edible fruit.
🌏 These plants thrive in Southeast Asia, especially in countries like Thailand, Malaysia, and Indonesia.
🌞 They require a warm, humid climate and well-drained soil for optimal growth.
🐝 Pollination is carried out by bats and insects, which are vital for their reproduction.
🍽️ The fruit is famous for its strong odor, which can be off-putting to some, but is highly valued for its unique taste.
🌱 Durian plants can grow up to 50 meters tall and typically take 4-5 years to bear fruit after planting.

Summary: Durian plants are tropical trees that produce the highly sought-after durian fruit, thriving in warm, humid climates of Southeast Asia.

# Why better prediction of cyclone intensity, heavy rainfall is needed

Two critical areas requiring further research are the prediction of tropical cyclone intensity, especially rapid intensification, and forecasting of heavy rainfall associated with landfall

Madhavan Nair Rajeevan

Tropical cyclones rank among the most devastating natural phenomena, with the potential to inflict significant destruction and loss of life. While the North Indian Ocean basin experiences fewer cyclones compared to other regions, it remains highly susceptible to their impacts due to densely populated coastal areas. This vulnerability was tragically highlighted by the Bhola cyclone of 1970, the deadliest tropical cyclone on record. Observational evidence indicates shifts in the patterns, intensity, and frequency of tropical cyclones, underscoring the need for adaptive measures in vulnerable regions.

Climatologically, the Bay of Bengal experiences a higher frequency of tropical cyclones compared with the Arabian Sea. In recent years, there has been a 52% increase in the frequency of cyclonic storms in the Arabian Sea, alongside a threefold rise in the duration of very severe cyclonic storms. There is a greater likelihood of cyclonic storms intensifying into severe cyclonic storms. In the satellite era, the accumulated cyclone energy over the North Indian Ocean has shown an increasing trend. These trends are driven by environmental factors such as rising ocean heat content and decreasing vertical wind shear.

In future climate change scenarios, anthropogenic climate change is likely to fuel more powerful tropical cyclones. Additionally, the tropical cyclone precipitation rates are projected to rise, driven by increased atmospheric moisture associated with global warming. Ocean basins may also experience a higher frequency of rapid intensification events, a poleward migration of the latitude of maximum intensity, and a slowing of the forward motion of tropical cyclones.

Cyclone Fengal created its place in history with its unusual trajectory and devastating impact on Tamil Nadu's coastline. Emerging as a low-pressure area over the southeast Bay of Bengal on November 23, it made landfall near Puducherry on the night of November 30. Uniquely, the system stalled upon reaching the coast due to a rare balanced steering flow, allowing it to maintain its intensity even after landfall until the evening of December 1. This persistence was fuelled by abundant moisture from saturated coastal soils, already soaked by preceding rains. The stalling cyclone unleashed unprecedented rainfall, with several locations across Puducherry and Villupuram districts recording 40-50 cm in a single day. Neighbouring districts, including Cuddalore and Tiruvannamalai, also experienced torrential downpours exceeding 20 cm within 24 hours. The deluge submerged vast stretches of farmland, resulting in catastrophic losses for farmers and severely impacting local livelihoods.

The India Meteorological Department (IMD) has established an impressive track record for accurately predicting the track and landfall of tropical cyclones over the last decade. Despite this, Fengal presented significant forecasting challenges due to its unconventional track, variable speed, and intense rainfall during landfall. While IMD successfully predicted the landfall near Puducherry nearly three days in advance, certain aspects of the cyclone's behaviour were difficult to forecast. For instance, its north-eastward movement on November 27 was not accurately predicted, and the slow progression or stalling near the coast also posed challenges.

More broadly, weather prediction models often struggle with forecasting the heavy rainfall associated with tropical cyclone landfalls, a limitation that was particularly evident in Fengal's case. None of the prediction models accurately predicted the exceptional 24-hour rainfall totals exceeding 40 cm recorded in some areas. Limitations in observational data over oceans, and the complex cloud dynamics within the cyclone contribute to forecasting difficulties, necessitating continuous advancements in modeling techniques and real-time data assimilation. Two critical areas requiring further research are the prediction of tropical cyclone intensity, especially rapid intensification and forecasting of heavy rainfall associated with landfall. These challenges are becoming increasingly urgent as IPCC climate models project more intense cyclones, accompanied by heavier precipitation and slower translation speeds.

## Critical need

The post-monsoon cyclone activity of 2024 highlights the critical need for sustained investments in advanced forecasting technologies and research to address existing knowledge gaps.

Despite significant progress, achieving precise tropical cyclone predictions remains a great challenge. It is imperative to prioritise measures that safeguard lives, livelihoods, and ecosystems from the devastating impacts of tropical cyclones.

*(Madhavan Nair Rajeevan was former Secretary to the Government of India and presently the Vice Chancellor, Atria University, Bengaluru)*

## Advanced forecasting technologies needed

Precise tropical cyclone prediction still remains a great challenge

- The Bay of Bengal experiences a higher frequency of tropical cyclones compared with the Arabian Sea
- But in recent years, the frequency of cyclonic storms in the Arabian Sea has increased by 52%, and the duration of very severe cyclonic storms has increased threefold
- The accumulated cyclone energy over the North Indian Ocean has been increasing due to rising ocean heat and decreasing vertical wind shear
- Eight low-pressure systems formed over the North Indian Ocean during the 2024 post-monsoon season (October-December)

**Heavy downpour:** In Puducherry, Cyclone Fengal dumped 48.4 cm of rainfall in 24 hours.

- Of the eight low-pressure systems, four intensified into depressions and two developed into cyclonic storms — Dana in October and Fengal in November
- Fengal stalled upon reaching the coast due to a rare balanced steering flow, allowing it to maintain its intensity even after landfall
- IMD successfully predicted the landfall near Puducherry but Fengal's north-eastward movement and the slow progression were not accurately predicted

# Topic →Tropical Cyclones: Impacts and Predictions

## Overview of Tropical Cyclones

Tropical cyclones are among the most devastating natural phenomena 🌪️
Significant potential for destruction and loss of life 💔
The North Indian Ocean basin is particularly vulnerable due to dense populations 📍

## Historical Context

Bhola Cyclone of 1970: The deadliest tropical cyclone on record 📅
Shifts in patterns, intensity, and frequency necessitate adaptive measures 🔄

# Climatic Trends

**Bay of Bengal:** Higher frequency of cyclones compared to the Arabian Sea 🌊

**Recent Increases:**

- 52% increase in cyclonic storms in the Arabian Sea 📈
- Threefold rise in very severe cyclonic storms ⛈️

**Accumulated cyclone energy is trending upward due to:**

- Rising ocean heat content 🌡️
- Decreasing vertical wind shear

## Future Projections

Climate change is expected to fuel more powerful cyclones 🔥
Increased precipitation rates due to higher atmospheric moisture ☔
**Possible changes:**
- More rapid intensification of cyclones ⏩
- Poleward migration of maximum intensity 🌍
- Slower forward motion of cyclones 🐢

## Case Study: Cyclone Fengal

Emerged as a low-pressure area over the southeast Bay of Bengal 📍

Unusual trajectory and significant impact on Tamil Nadu's coastline 🌅

**Rainfall Impact:**
- Locations recording 40-50 cm in a single day 🌧️
- Catastrophic losses for farmers and local livelihoods 🚜

## Forecasting Challenges

**IMD's strong prediction record but faced challenges with Fengal:**

- Unconventional track and variable speed 🛤️
- Struggles with predicting heavy rainfall, particularly during landfall ⏳

Need for continuous advancements in modeling techniques and real-time data assimilation 🔍

## Critical Needs

**Investment in Research:** To address knowledge gaps in cyclone forecasting 💡

Prioritize safeguarding lives, livelihoods, and ecosystems from cyclone impacts 🌱

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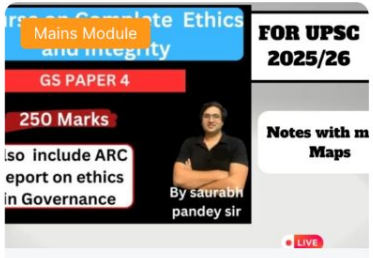


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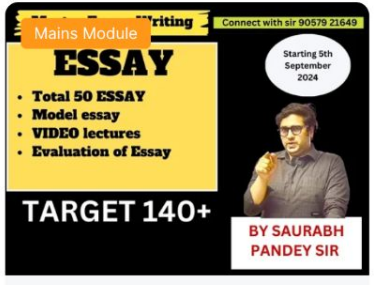


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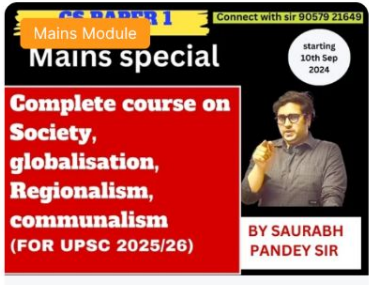


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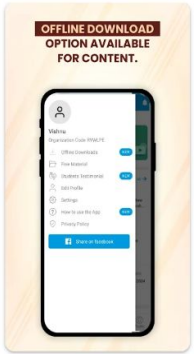



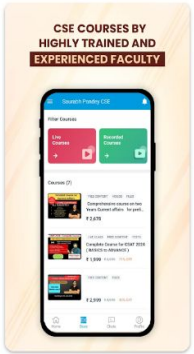


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**Q Essay topic →** “No one who does good work will ever come to a bad end, either here or in the world to come.”